NATURE

No. 3855 SATURDAY, SEPT. 18, 1943 Vol. 152

CONTENTS

	Page
Functional Development of International Organization	309
Blue-Prints for Post-War Britain. By G. D. H. Cole	312
Weed Control. By Dr. Winifred E. Brenchley	314
Race, Class and Mating in the Evolution of Man. By Dr. C. D. Darlington, F.R.S.	315
A Miocene Anthropoid Mandible from Rusinga, Kenya. By Dr. L. S. B. Leakey	319
Conference on the Future of Archæology. By Kathleen M. Kenyon	320
Obituaries :	
Prof. Frank Schlesinger. By Sir H. Spencer Jones, F.R.S.	321
Mr. C. V. B. Marquand. By Dr. T. A. Sprague	322
News and Views	323
Letters to the Editors :	
Inhibition of Urease by Penicillin.—Lieut.-Colonel Joseph C. Turner, Captain Frederick K. Heath and Boris Magasanik	326
Iron Excretion and Metabolism in Man.—Dr. R. A. McCance and Dr. E. M. Widdowson	326
l-Lysine Decarboxylase : Preparation of Specific Enzyme and Coenzyme.—Ernest F. Gale and Helen M. R. Epps	327
Ultra-Violet Light and Apparent Vitamin C.—Dr. Frank Wokes	328
Vitamin C and Carbohydrate Metabolism.—Sachchidananda Banerjee	329
Short Wave-length Limit of the Continuous X-Ray Spectrum and Determinations of *h*/*e*.—Per Ohlin	329
Variations of Ultra-Violet and Daylight Rays.—Dr. J. R. Ashworth	330
Spore-forming Bacteria in Potatoes.—Dr. W. J. Dowson	331
Colour of Red Blood Corpuscles.—Dr. John R. Baker	331
Length of Life of Sperms in the Woodlouse *Armadillidium vulgare* Latr.—H. W. Howard	331
Ocular Muscles and Vision.—Dr. F. W. Edridge-Green, C.B.E.	331
Research Items	332
Bulb Formation and Flower Production in Onion Plants Grown from Sets. By O. V. S. Heath and M. Holdsworth	334
Research on Early Man in Burma. By M. C. Burkitt	335
A Giant Camera	335

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831
Telegrams: Phusis Lesquare London
Advertisements should be addressed to
T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone: Temple Bar 1942
The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad.

All rights reserved. Registered as a Newspaper at the General Post Office

FUNCTIONAL DEVELOPMENT OF INTERNATIONAL ORGANIZATION

DR. W. E. ALLEE'S proposed address as vice-president and chairman of Section F of the American Association for the Advancement of Science, "Where Angels Fear to Tread : A Contribution from General Sociology to Human Ethics", which has recently appeared in *Science* (**97**, 517–525, June 11, 1943) is of special interest in view of current discussions on the establishment of a working peace system and on the problem of Germany. Cumulative studies in social biology lead Dr. Allee to the conclusion that co-operative forces are biologically more important and vital than their opposite. He insists that the data of biology, if properly understood, are definitely opposed to any social philosophy based primarily on the idea that might makes right in international contacts or in international relations.

Prof. Allee believes that a special obligation rests on biologists to attempt to make sure that mankind does not lose the peace that will follow the present War, in which connexion he urges that those nations will have the best opportunity to win the peace who emerge from the present conflict with their programme of basic research most nearly intact. He suggests that the biological drives towards natural co-operation support the general tenor of a programme in which, first, we should not look forward to punishment for the defeated *peoples*. Secondly, in under-nourished Europe and elsewhere, we should administer relief according to ability to furnish it and to need only, not according to politics or boundaries. Further, we should set up a world organization which will, in principle from the start, and in detail as much as possible, treat victors and vanquished alike. Similarly, if we disarm other nations we must be willing to disarm ourselves, and if we subject any major portion of the world to the control of an international police force, we ourselves should accept a similar control on the same general principles. Again, in regard to curtailment of sovereignty, national governments of powerful peoples, along with those of weak peoples, must discontinue the present policy of determining their own actions in all matters deemed by themselves to lie within the limits of their own sectional interests. All nations alike should be educated for the processes that make for change by the use of peaceful, non-violent techniques. All nations and many classes within nations need, and will continue to need, such education for a long time to come. Finally, Dr. Allee suggests that we should behave towards the defeated peoples from the outset in the way in which Great Britain behaved towards the Boers, and the United States towards the Filipinos, at the turn of the century. Man could, if he chose, focus on his innate drives towards co-operation and attempt to set up a new order based primarily on some such altruistic pattern as this.

The task should be the easier, Dr. Allee considers, because modern biological teaching in these matters resembles many of the social doctrines of the ethical religions, and he urges biologists, as such and as

citizens, to try to assist in guiding the existing trend towards a workable world organization along lines which accord with sound biological theory. In such matters the idealist with the long-range view is often the true realist.

The very full study of the problem of Germany which has been issued by the Royal Institute of International Affairs* reaches several conclusions which find support in these views of Dr. Allee. The study is essentially one of the problem of providing for the security of Great Britain in a world in which a dangerously bellicose people like the Germans will continue to exist. It is clear from the start that some compromise between the extremes of force and co-operation must be found: the utter extermination of the Germans or their perpetual enslavement would not be tolerated by the British mind. The Atlantic Charter, in fact, has already committed us to such a compromise, but while the four freedoms are guaranteed to victors and vanquished alike, the vanquished are not to be free to threaten their neighbours again.

A main purpose of the report is to determine at which points of the field each of these two principles of force and co-operation is to prevail. If we are to achieve our purpose, our aims and principles must not be allowed to get in each other's way, and the most valuable part of this study lies in the final section which analyses the prospects of co-operation. This is not to be considered as disparaging to the earlier sections, in which the practical difficulties of disarmament are frankly faced, including the factors which determine the relative strength of Germany and Great Britain which might influence a conflict between the two countries, the possibilities of territorial changes and a new political structure in Europe, the internal government of Germany, economic policy and the control of Germany's war potential. This is a necessary prelude, for the final argument is based on the review of these difficulties and the conclusions, notably that poverty will breed war and that the prevention of German re-armament could be ensured by methods which do not necessarily involve wholesale interference with the capacity of German industry for peace-time production, to which this review leads.

This final section covers much ground that is common to the report on "Education and the United Nations" (see NATURE, August 14, p. 169). Unless the idea of co-operation as a possible and natural state of international relationships lodges in the German mind, displacing the notions of inevitable wars, master and slave races, the rights of the strong and the like, Germany will continue to be a country alongside which it is impossible to live. In rejecting both the extreme views of complete scepticism as to the possibility of changing the German outlook and the over-confidence in the power of education alone to effect great changes, the paper from the Royal Institute of International Affairs is in harmony with Dr. Allee's views. The root of the matter is that a new German outlook, though not impossible, will be necessarily a slow growth, and that, though it can be promoted or retarded by the acts or omissions of foreigners, it must essentially be a spontaneous German development. It will, moreover, be brought about less by precept than by the workings of experience and a new environment.

It is important, therefore, that the policy of the democracies should be such as to favour any genuine attempts by co-operative-minded elements in Germany to establish free institutions. That is one reason why the policy of the Allied Military Government of Occupied Territories (AMGOT) is being watched with such close interest: the other is its importance to the related question of political warfare. While it is impossible at the moment to form any sound idea as to the extent or strength of such co-operative influences in Germany, the Christian Churches may well be found, as this paper suggests, to form a well-tried bridge for an understanding with the West.

Even if the Germans themselves are ready for change, it will not be easy to reciprocate, and on the question of assuming positive responsibility for the whole educational system of Germany the paper is reserved. It lays more stress on the probability of response to American influences, but it recognizes that the German war party will continue to represent Britain as a decadent country. To counter this a vigorous reconstruction policy and programme for Britain, in which social security and educational reform are two essential elements, is important; but it is above all necessary that there should not again be the possibility of Germany attempting to represent defeat in war as victory. The manifest defeat of Germany by force of arms is the first step in the re-education of Germany, even if the lessons of that defeat are not immediately learned.

The real problem here is the time at which vigilant co-operation can be adopted as our policy instead of punishment. However complex may be the reactions of Germany to defeat, we must set ourselves to discover some underlying principle to which the United Nations as well as Germany can subscribe. The four freedoms of President Roosevelt are regarded by this Chatham House paper as providing the most comprehensive and authoritative new definition of a goal of common action. They have the advantage over the Atlantic Charter that they are addressed to the individual and not to the State alone, and are a specific challenge to the German tendency to interpret ideals in a private sense.

Even in good conditions, it will be no easy task to lead the Germans to care greatly for freedom, but that they should do so is the only basis of a tolerable relation with the democratic countries. Freedom they regarded as inefficient, as selfish and as unjust, and offering no convincing object to which faith and idealism could attach themselves. The plunge into Nazism was largely an attempt to escape from these inadequacies and contradictions, and any system which is held out as a possible ground of common international action must meet these needs.

It must first be efficient, and demonstrate that for desirable social ends it knows how to make full use

* The Problem of Germany: An Interim Report by a Chatham House Group. (Post-war Problems.) Pp. 92. 2s. 6d. net.

of the scientific and technical possibilities of the new industrial revolution. Secondly, it must be based on an enhanced sense of community, operative not only within but also, in some real sense, outside the frontiers of the State. Thirdly, it must not countenance the maintenance of privilege unconnected with any useful social function. Of one form of this evil the present generation, in Great Britain particularly, is increasingly impatient, and that is educational privilege. Only those educational systems which enable talent, integrity and character, wherever they are to be found, to reach a position of leadership, are in future likely to meet with general approval, and this should not be untrue of Germany. Finally, such a society would be bound to make great calls on the idealism of its members, although it is not within the social order itself that the ultimate springs of moral action arise, and it is ultimately on the ethical view of man as hitherto reflected in the moral attitude of Western civilization that we must depend for the antidote to the dehumanizing influence of efficiency.

While recognizing that security is important, this Chatham House paper puts the main emphasis on the possibility of pursuing common human purposes which transcend national frontiers. It does not indeed suggest that the State will cease to be the basis of international life or that we need no longer reckon with the factors of political ambitions and aggressiveness. On the contrary, it insists on just such a realistic attitude as Einzig in his "Can We Win the Peace ?" ; firmness of purpose is essential, and whatever policy of control or disarmament is adopted towards Germany should be one that will command the unfaltering support of Britain, not for two or three but for twenty or thirty years after the end of the present War. The main lesson drawn from the history of disarmament after the War of 1914–18 is not that technical difficulties in preventing Germany from re-arming are insuperable, but that the real danger-point is a weakening of the Allied will to prevent it.

The two chief points emphasized by the study are that military victory may be expected to create, not a better state of affairs, but an opportunity to create a better state of affairs ; and secondly, that those who recognize that international life must be lived co-operatively and more in perpetual adjustment and compromise must be content with short views. They can plan within wide limits their internal policy, but internationally they can do little more than decide the general direction in which they desire to go and do their best to ensure that the first steps lead in that direction. Although it is nowhere explicitly mentioned, the Chatham House group seems, in fact, to contemplate the functional development of international organization on which Prof. D. Mitrany insists in his paper, "A Working Peace System"*, also issued by the Royal Institute of International Affairs. It is pointed out, for example, that acceptance of the principle of 'freedom from want' implies as a general aim that the elementary human needs of food and shelter for all should come to be regarded as a first charge on the world's resources. At a higher level of initiative and adventure, the modern readiness to devise bold schemes of national improvement offers to the workers and technicians concerned the stimulus of conscious participation in a great social purpose. This is a matter of great importance in the German situation, both in regard to the unemployment situation and to the imperative necessity of breaking down and correcting the German quasi-monopoly of the higher technical skills over a large part of Europe.

Dr. Mitrany's argument starts from this need for continuous adjustment and settlement which the League of Nations did not, and could not, meet because its members failed to implement Article 19 of the Covenant, providing for the revision of treaties and other matters which might become dangers to peace, and insists on a pragmatic approach in a period of historical transition. He maintains that in place of providing a formal general framework of co-operation in advance, it is more in keeping with the present trend in emphasis from 'rights' to 'services' to organize international government along the lines of specific ends and needs. The sound method of peaceful change, he urges, is to do internationally what it does nationally : to make changes of frontiers unnecessary by making them meaningless through the continuous development of common activities and interests across them. A different complexion would be put on the problem of security if frontier lines became overlaid with a natural growth of common activities and common administrative agencies. Moreover, functional organization offers some prospect of mitigating the difficulties which arise out of State claims to equality by evolving arrangements which show a measurable and acceptable relation between authority and responsibility, relating authority not to sheer power but to the weight of responsibility carried by the several members.

The experience of the technical committees of the League of Nations as well as that of the International Labour Organisation lends support to this view of Dr. Mitrany, and there are precedents in the European Danube Commission which also encourage the view that specific functional arrangements may well tame the principle of State equality. At least we can find here a further reason why the organizations set up specifically to further our immediate war purposes, such as the Combined Production and Resources Board, and the Combined Raw Materials Board, should not be scrapped immediately the War ends, but utilized to serve post-war needs. In particular, the value of such organizations in post-war relief and reconstruction is apparent, and the draft agreement for the establishment of a United Nations Relief and Rehabilitation Administration and the formation as an outcome of the Conference on Food and Agriculture at Hot Springs of an interim commission to plan a Permanent International Organization for Food and Agriculture, parallel with the International Labour Organisation in scope and open to all belligerents and non-belligerents alike,

* A Working Peace System : An Argument for the Functional Development of International Organization. (Post-war Problems.) By Prof. D. Mitrany. Pp. 56. 1s. 6d. net.

are definite steps in the direction of functional organization.

Discussing the broad lines of functional organization, Dr. Mitrany suggests that public action should only be taken where, when and in so far as the need for common action becomes apparent, and is accepted for the sake of the common good. Only in this way can international organization be well combined with national freedom. Activities should be selected specifically and organized separately, each according to its nature, the conditions under which it has to operate and the needs of the moment. No rigid pattern is required or desirable, and devolution, too, should follow functional lines, functional dimensions determining the appropriate organs.

While each agency could work by itself, the question of wider co-operation must be faced. The co-ordination necessary within the same group of functions, either for technical purposes or for wider functional needs, would be the first stage towards a wide integration. The group concerned with communications illustrates this point. Rail, road and air transport in Europe will obviously require technical co-ordination in such matters as time-tables and connexions, etc., but a wider functional co-ordination will be required to secure the distribution of passenger and freight traffic for the most economic performance. The transition from the co-ordination of several groups of functional agencies to international planning is natural, but overall political authority does not, in Dr. Mitrany's view, appear to be an essential. The general watch over the policies of several joint agencies could well be effected through some such representative body as the Assembly of the League of Nations or the governing body of the International Labour Organisation.

A more fundamental question is that of the structure of the functional controls and the question of representation. Here Dr. Mitrany seizes on the element of professional competence which proved the secret of the success of so many of the League's technical committees, and would make any claim to a share in control depend on a corresponding and evident capacity for performance. On that test smaller States could also qualify, and participants would vary, thus avoiding an exclusive accumulation of influence by a few countries. The same test would govern the extent of the powers of control, and the performance would be practical and measurable, with a periodical balance-sheet, more definite and suitable for examination than the reports to the Mandates Commission, through which the work and policy of each agency could be closely controlled. Dr. Mitrany relies on a personnel which would be largely technical and permanent to develop both a professional pride and a vested interest in good performance, and he adds that not only would the growth of such a service be the best insurance against possible abuses, but also the functional method, by concentrating all attention on a practical public service, is more likely than any other to breed a new conscience in all those concerned with international activities.

Such functional developments will not in themselves create a new system, but, what is much more important, national problems would then appear and be treated for what they are, namely, the local segments of general problems. The system would not be endangered by political or social experiments of one of the participants or even by secession of a member. Authority would derive from the performance of a common task, and be conditioned by it; and while functionalism might lead in time to a federal political system, that would come, if at all, by free organic growth, a natural process of selection and evolution.

The vital questions are, "What are the rightful ends and what are the proper means for achieving those ends?" Dr. Allee has clearly assisted the formulation of those ends on a basis of scientific as well as social expedience. Dr. Mitrany's powerful plea for functionalism as the means derives important support, as he himself points out, from our present experience with the Combined Raw Materials Board and like agencies, and is also favoured by some of the smaller nations, as Dr. van der Tempel has shown in his recent book ("Keep the Lamps Burning." Hale, 1943. 10*s*. 6*d*.). There can be no doubt as to the value of the organization for relief and reconstruction in Europe in building up a common interest in peace. That may well make a vital contribution in taking certain interests and activities out of the mood of competition and into one of co-operation for the common task. Together these addresses and papers afford impressive evidence that, difficult as is the task before us, it is not insuperable. Given vision, determination and readiness to use the organization, the tools and the technique that lie to our hands, the task of fashioning a world order in which the four freedoms are incorporated and in which Germany herself occupies a fitting place in the European system, may well prove neither so impracticable nor so difficult as victory itself might have appeared when Great Britain stood alone against the Axis Powers in the fateful summer of 1940.

BLUE-PRINTS FOR POST-WAR BRITAIN

Economic Reconstruction

A Study of Post-War Problems. By J. R. Bellerby, assisted by Phyllis Deane, E. Victor Morgan (in Vol. 2), M. Compton and others. Vol. 1: National, Industrial and Regional Planning. Pp. 396. (London: Macmillan and Co., Ltd., 1943.) 21*s*. net.

PROF. BELLERBY is ambitious. In this volume, which is to be followed by a second dealing with international planning, he sets out to provide the blue-prints for a complete system of post-war planning in Great Britain, covering every important aspect of the nation's economic life. Or rather, he presents two different sets of plans, one based on a continuance of private enterprise and the other on a remarkably rapid transition to a nearly complete system of State ownership and collective industrial enterprise. At certain points, notably in the earlier stages, the measures recommended in the alternative plans are largely the same; but the divergence

increases very fast after the initial measures designed to deal with the immediate emergency following on the cessation of hostilities. In both plans, it is taken for granted that there must be a profound departure from pre-war policies and assumptions, and that the State must, in one way or another, take the full responsibility for maintaining employment at a satisfactory level, and therewith for raising effective consuming power in steady correspondence with the expansion of the power to produce. It follows that Prof. Bellerby's system of private enterprise involves a very large element of public control, including the effective control not only of the volume of investment, but also of prices (including wages), interest rates and monetary conditions generally, and also the establishment of an assured minimum level of consuming power. In effect, the main difference between the two plans is that in one the State is to undertake directly the conduct of the main industries in accordance with its own co-ordinating economic plan, whereas in the other the execution of the plan, and even a large share in its making, are to be delegated to special organs representative of industry itself.

It is somewhat unfortunate that Prof. Bellerby makes, without anywhere so far as I can see clearly arguing, the assumption that Great Britain will have to choose between these two plans absolutely, and cannot either choose a cross between them, or something different from either. There are, he says, only two economic systems—private enterprise and State enterprise; and between these an absolute choice will have to be made. He says categorically, "From the point of view of planning, a partial change will avail little. The effective choice is between the system of Private Enterprise on the one hand and complete State-ownership on the other." True, later on one discovers that he does not really mean quite this; for he proposes, for some time at any rate, to retain a considerable private sector within the system of State-ownership. But the general scheme of his book is based on the idea of this absolute choice between two systems; and this is where I find his treatment exceedingly unrealistic. For, even if there are in the last resort only two alternative systems (and where, in such a categorization, do such things as the co-operative movement or the London Passenger Transport Board fit in?), these two systems have many variants, and to say that we must choose between them is not the same thing as saying that we must choose between the particular versions of them presented by Prof. Bellerby. For example, if we choose private enterprise, are we really compelled to have as its accompaniment his peculiar plan for an all-party parliamentary planning conference working side by side with an industrial and economic parliament consisting mainly of employers' and workers' representatives in equal numbers? Are we compelled to accept his plan for a price-fixing board which is to have complete final control over wages in all industries, as well as over prices? Or, if we opt for State-ownership, must we really take over 75 per cent of the national productive activity of the country in a few gigantic swallows spread over but a very few years?

This is surely a false dilemma. It may be true that we shall have to make up our minds whether we wish the driving force in post-war economic policy to be socialistic or capitalistic, and to get ourselves a Government in accordance with our general preference. But it does not at all follow that the Government we get must pursue a 100 per cent policy of either Socialism or Capitalism. If Prof. Bellerby were contemplating the possibility of a socialist system applied as the outcome of a revolution *à la Russe*, one horn of his dilemma might exist; but he explicitly excludes such a situation from his subject, and assumes a post-war economic order that is to be built up by constitutional means. The result is that he is apt to impale himself on the horns of his own unusual dilemma. It is nonsense to suggest that a plan could not work at all unless it had precisely the composition postulated for one or other of his two alternatives.

It is a pity that Prof. Bellerby has marred the shape of his book in this way; for there is in it a great deal that is good. He is much more prepared than I am to trust representative bodies of employers and workers to make plans which will be free from restrictive taint and will be constructed solely with a view to the common benefit of the people; and he seems to me to be unrealistic in his handling of the extremely complex and difficult problem of price-control, and still more in his proposal to make wage-control a secondary function of his price-controlling body. As against this, there is much that is excellent in his discussion of State planning policies and methods, in his account of the problems and prospects of each of the leading industries, and in his attempt to distinguish between the probable stages of economic emergence from war to peace. His discussion of these matters involves too much detail to lend itself to summary; and it is to be hoped that what I have said earlier by way of criticism will not deter any reader from studying it.

The fundamental problem of economic planning, as Prof. Bellerby envisages it, is the maintenance of an adequate level of consuming power. He accepts completely the view that the radical disease of capitalism in the pre-war world was its tendency to generate crises of under-consumption. Indeed, he states this position in terms that are a great deal nearer Hobson than Keynes, and lays proportionately large stress on measures for the maintenance and increase of consuming power, both temporarily in the emergencies that may be expected to arise during the successive phases of reconstruction, and also permanently. He wants, as immediate post-war measures designed to be permanent, both family allowances and a guaranteed minimum standard of income: he lays stress on the beneficent effects to be looked for from the repayment, at the right times, of service gratuities, post-war credits, refunds of excess profits tax, and so on. But he goes further than this, and contemplates the actual creation of purchasing power by way of all-round gifts to consumers as one of the means that it may be desirable to use in combating post-war depression. I am glad to see that, in connexion with these proposals, he recognizes the imperative necessity of avoiding, during the critical period of reconstruction, any binding stabilization of the pound in relation to gold or the dollar, though he does appear to contemplate that such stabilization may come later, as the accompaniment of an agreement to follow common expansionist policies in the conduct of economic affairs.

In general, Prof. Bellerby has written an interesting, and often suggestive, book, but has written it on a bad plan. Some of his dogmatism is due to the attempt to crowd in too much and to cover more ground than one man can cover in one book, how-

ever richly he may be endowed with research assistants. But some of it is due to a mistaken striving after clarity, in face of possibilities so varying that he is tempted to exclude most of them, and to choose just those which fit in best with his general plan. He is at his worst when he is discussing his second alternative—State-ownership; further, he makes all sorts of unwarrantable assumptions about the way in which industries would have to be nationalized, and the forms which compensation (or the absence of it) would necessarily take. His discussion of private enterprise is much better, because there he is dealing with something that exists, and has to begin by taking it as it is, and not by constructing an unrealistic model and then treating it as if it were the only possible variant. If this review is less favourable than the book deserves, it is because this state of unrealistic formalism in its author has annoyed me, and caused me to do less than justice to the particular things he has done well.

G. D. H. COLE.

WEED CONTROL

Weed Control

A Textbook and Manual. By Prof. Wilfred W. Robbins, Prof. Alden S. Crafts and Richard N. Raynor. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. xi+543. (New York and London: McGraw-Hill Book Co., Inc., 1942.) 35*s*.

THE problem of weeds and their control or eradication is one which increases in importance with modern advances in agricultural practice. On land giving low returns, due to poor quality of the soil, poor cultivation or other factors, it may be uneconomic to adopt any intensive methods of weed control. On well-cultivated land, in good heart, and bearing heavy crops, it is justifiable and often profitable to expend considerable time and money in combating weeds in order to bring the reduction of crop due to competition to the lowest possible level. Much experimental work has been done and much written on the subject, and Messrs. Robbins, Crafts and Raynor have rendered a great service by gathering into one volume a comprehensive survey of this field of activity.

The rapidity with which weeds spread from one area to another emphasizes the need for a primary method of control, involving rigid inspection of imported seeds and prompt dealing with initial infestations of bad weeds. The worst pests in many countries, such as blackberry, Russian thistle, creeping thistle and morning glory owe their unenviable position to neglect of this elementary precaution. Furthermore, changes in methods of cultivation may cause native species to behave as weeds.

The harm caused by weeds is due not only to their demands upon the limited amounts of food and water available in the soil, the water requirements of bad weeds often being greater than that of the crops. Heavy expenses and monetary loss also are involved in control and eradication, in seed cleaning, clearing ditches and in the reduction of the market value of crops. The quality of milk, grain, hair and wool is often reduced, and certain weeds also act as alternative hosts for various crop pests.

Control and eradication need to be distinguished, as the latter is seldom economically possible, except in such cases as dodder. The life-history of weeds is closely related to effective methods of control, and for large-scale work very special methods have been evolved, as flooding by water, heat treatment by flame throwers and steam boxes, and paper mulch in areas of very rapid growth. There is, however, no universal panacea for killing weeds, and, to quote the authors, "general recommendations must be interpreted in the light of the specific situation, amended to meet the requirements imposed and tempered with judgment based on local experience".

On arable land the time-honoured method of weed control by careful cultivation is still often the most economical procedure, but great strides have recently been made with chemical agents. These may act in various ways: as herbicides killing by contact with the leaves or by being translocated through the plant tissues, or as soil sterilizers preventing the growth of plants over varying periods of time. Some chemicals, as sodium arsenite, are non-selective and kill all vegetation by contact; others are selective, killing weeds but sparing crops of certain types, as occurs with charlock among cereals. This group of weed killers includes highly soluble fertilizers and toxic compounds which are reduced in toxicity by contact with soil.

Translocated sprays, the physiological action of which is discussed, pass downwards through the tissues, killing as they go. Arsenical sprays and sodium chlorate fall into this group. The same weed killer can be used in various ways, according to the rate of application and the environmental and soil conditions.

Detailed accounts are given of the more important weed killers with full reference to the work of many investigators, a bibliography being appended to each chapter. For convenience of reference these authors are gathered into a general index, though this does not appear to be complete, as such an important investigator as Korsmo fails to appear therein, although adequate reference is made to his work in the text.

Weed control on special areas as railroads, paths, etc., is effected by soil sterilants, among which sodium arsenite stands almost alone as regards permanence. All others are more or less temporary in nature, the type of soil and environmental conditions affecting their action considerably.

Weed control by chemical means entails of necessity special machinery, much of which is effectively illustrated. Consideration is also given to various special problems, as the weeds on grassland and on uncropped areas, control of dodder, and stump- and tree-killing, the latter sometimes being dealt with by injection of poison. Certain weeds receive special attention; for hoary cress, morning glory, sheep sorrel, Russian thistle, and puncture vine, among others, are so dominant where they occur that they constitute major problems. In the appendix various useful tables and lists are given, including an estimate of the number of seeds produced by various weeds, and examples of native species in various areas which have now usurped the role of weeds.

The authors are to be congratulated on producing a book which will be of great value to all who deal with the land, and which should stimulate experimental research on practical and economic methods of weed control.

WINIFRED E. BRENCHLEY.

RACE, CLASS AND MATING IN THE EVOLUTION OF MAN*

By Dr. C. D. DARLINGTON, F.R.S.

The Background

QUESTIONS of race in man have been the subject of increasing dispute for the last hundred years. Most of the positive opinions that have been advanced owe little to our recent knowledge of heredity, but they show the background on which we have to work in applying this knowledge. Our starting point has to be the primitive or Old Testament view. It was expressed by Archbishop Trench when he gave the opinion that the savage "is a dead withered leaf, torn violently away from the great trunk of humanity, and with no more power to produce anything nobler than himself out of himself, than that dead withered leaf to unfold itself into the oak of the forest"[1]. On the other side Darwin opposes to this pessimism the more hopeful view that "all the races of man . . . are descended from a single primitive stock" and have come to differ in heredity during a continuing process of improvement[2].

These opinions differ in the direction of change, backwards or forwards, but they agree that there has been change. Powerful hereditary differences both in mind and body distinguish the races of man. A third view, which springs from the New Testament and also owes something to Rousseau and Marx, emphasizes, both for race and class, the importance of differences in the environment rather than in heredity. Such a cleavage of ideas as to the genetic evaluation of human races is assisted by the facts recognized by Darwin. "If we reflect on the weighty arguments," he writes, "for raising the races of man to the dignity of species and the insuperable difficulties on the other side, in defining them, the term 'sub-species' might here be used with much propriety. But from long habit the term 'race' will perhaps always be employed"[2].

To-day the "weighty arguments" and the "insuperable difficulties" are still at war. On one side stand those who, following Gobineau, assert that modern peoples spring from hypothetical pure races, from one of which, happily superior to the rest, they themselves are descended without contamination. Further, they hold that races described as Nordic and Mediterranean, and even their mixtures, can be recognized by the forms and features of individuals[3]. Even, by a further stretch of theory, they take language as an independent and sufficient criterion of race, and it is from this simple view that the "ethnographical" maps which appear in our atlases take their title. At the same time, on the other side are those who say that every population "includes many types and their various combinations" and therefore "the word *race* should be banished, and the descriptive and non-committal term *ethnic group* should be substituted"[4]; and further, "the so-called racial explanation of differences in human performance and achievement is either an ineptitude or a fraud"[5]. Again, by a stretch of this theory, it is held that primitive peoples can, by prolonged subjection to the benefits of European rule, be brought to develop a culture comparable with our own, when they will be, as it is said, ripe for self-government.

Both these lines of argument are now being politically applied. It is therefore worth our while to try to form an opinion of their scientific value. Such an opinion can, I believe, be reached on the basis of the postulates, and on the analogy of the conclusions, of experimental genetics.

* Substance of an address given to the Association of Scientific Workers in Cambridge on July 16.

Mating Systems

We must begin, following the example of Darwin, with something we understand better than man, namely, the breeds and races of domesticated plants and animals. If a plant is regularly self-fertilized—a rare condition—we can agree that all the descendants of one plant, or of a group of indistinguishable plants, will, as a rule, conveniently constitute a race or variety. Even so, if they are divided into groups that undergo mutations and are differently selected, the groups will become separable, and sometimes are separated, as distinct races.

When we turn to cross-fertilized plants and animals we find quite another state of things. It is now a question, not of one parent, but of the group from which any individual may take its two parents, and from which all individuals will later take their ancestors. The mating group and the group of common ancestors are the same type of unit. In no such group will all the individuals be alike, and they may be highly diverse. To what then does the group owe any unitary character it may possess? It owes its character to what we may call its chromosome pool. It is a property of germ-cell formation that half the chromosomes of the parent are rejected in the formation of each germ-cell. In a stable population therefore, where two parents have two offspring, one quarter of their chromosomes are lost to the chromosome pool in the next generation and one quarter are doubled in frequency; only a half reappear once. By mere chance the pool suffers regrouping and by mere chance two separate pools will be differently changed, and, if they are small, rapidly changed[6].

There is something more than chance, however, at work. Different groups are inevitably differentiated by selection whether natural or artificial. The original and subsisting function of sexual reproduction is to expose to selection all the gene-combinations it can produce at every level of their activity and in the greatest possible range of environments. The conditions of survival and reproduction of the individuals produced by the recombinations of genes and chromosomes are different in different countries, climates and ways of life. Selection is continually changing the character of the chromosome pool by differences of survival and of fertility. Every couple will not have two offspring; and most of the genes concerned are individually invisible in their effects. Furthermore, selection is throwing away, not only unsuitable genes, but also unsuitable combinations of genes, and so balancing the genes contained in the chromosomes against all the others with which recombination from the pool brings them into relationship. This internal selection is producing what Mather calls a "relational balance" which is characteristic of the particular mating group[7]. Thus at three levels, the environmental, the genetic, and the jointly genetic and environmental, cultural, level any mating group has a unified selective response which differentiates it from all others.

With two inbred groups, the cross-breeding of which is prevented, the point at which we shall begin to refer to them as races is then a question of *ad hoc* convenience. We can merely say that that point will be

reached more quickly if the groups are smaller; if the original differences between them, and the heterogeneity within them, are greater; if their mutation-rates are higher; if their selection is more rigorous or more divergent.

In our domesticated races we are accustomed to use as our index of pure-breeding certain clear genetic differences, the 'points' of the breed. These are determined by major or 'marker' genes. We cannot attend so strictly to the minor or 'polygenes'. Artificial cross-fertilized breeds are therefore always more heterogeneous than they seem. Marker genes are also used by the classifiers of wild plants and animals. They are not, however, the most important agents in separating natural groups in animals or man. This is recognized by the use of geographical and historical criteria in addition to morphological ones. We now know that natural groups have often become intersterile without any difference having been noticed by the morphologist; and if invisible polygenic differences separate races their internal homogeneity due to their inbreeding must also be invisible. Natural races are, therefore, more homogeneous internally than they seem, by comparison with artificial breeds. Thus convergence as well as divergence is partly cryptic, and so far as it is cryptic its only measure, apart from experiment, is the breeding history of the group.

Group Limitation in Man

It is our business to find out how this group effect has worked in the history of mankind. Man is derived from a group, at the beginning of his independent history, of ten, or perhaps a hundred, thousand ancestors. These common ancestors were genetically diverse, perhaps as diverse as any living men. Their progeny have continually expanded in numbers, and these numbers alone have set the *genetical* limit to the inter-breeding group in man. Within this expanding population, however, there have been *physical* limits to the effective breeding groups and these have not always expanded. Mobility has depended on geography and on civilization, either of which may help or hinder it. Navigation helps, agriculture hinders. Finally, there have been *social* limits to the mating groups which restrict the choice of mate to a fraction of those who are physically accessible. They depend on man's intellectual discrimination, which itself has developed with his cultural evolution. They have, therefore, been applied with increasing rigour as the density of human population has increased; and, though cultural in origin, in effect they are always genetic as well, since culturally separated communities must always become genetically distinct.

When the cultural barrier arises from the physical limitation we have the characteristic origin of race. When it arises from a social differentiation we have the origin of class. When the two are combined and stabilized we get the formal climax of caste in India.

How large in effect are the mating groups into which man is divided? Keith[9] has surveyed the action of 'tribal instincts' in restricting their size in primitive peoples. The invisible divisions of civilization can be measured in other ways. One is from the frequencies of the blood group genes[9,10]. The distinctness of Jewish and Gipsy minorities from the neighbouring majorities shows the strictness of their previous inbreeding. Prof. Fisher tells me that, in rural Ulster, groups with English and Scottish surnames still remain distinct; with a minor religious distinction scarcely any intermixture has occurred during ten generations. Church records of Ulster communities in North Carolina show that the same endogamous habits have been carried across the Atlantic[11]. In the same way the frequency of conditions due to recessive genes can be used to establish the separation of groups. If deaf mutes are 4½ times as frequent among Jews as among Gentiles in Berlin, the two groups must be effectively separate breeding units[12].

Again, Dahlberg has inferred the average size of the group among which mates are chosen from the frequency of cousin marriage[13]. This frequency has changed in Bavaria, for example, as though the size of the group had increased during the last fifty years from 2,000 to 5,000. Increased mobility has been breaking up the agricultural breeding system.

Other methods of measuring the mating system and its effects, using the frequency of *X*-chromosome genes and of heterozygotes, will doubtless be used in the future[12,13,14]. But we can already infer in these different ways that the mating group among civilized peoples, although less stable, is not always larger than among primitive peoples and is smaller than is usually believed by the individuals concerned.

Adaptation of Classes

A part of the subdivision of a race into smaller mating groups is inherently adaptive. The closer social intercourse within groups following the same trade favours the mating of similarly adapted individuals. This effect is reinforced by assortative mating. As Pearson found, there is correlation between the heights of husbands and wives. Like mates with like. All over the world, not only in India, fishermen, cotton-workers, coal-miners and peasants are inbred groups. Moreover, groups lose those individuals who are least suited to them. Thus selection will exaggerate itself. First a man selects his mode of life and then his mode of life selects him. The saying that it takes three generations to make a cotton spinner may well reflect this process. Nor can we doubt the advantage that has come to the world from the assortative mating of musicians. These are processes which will continue to be refined by each new development of human culture so long as individuals are free to choose their mates.

In monogamous societies based on hereditary wealth, economic differences cut across adaptive differences and establish a still finer subdivision of mating groups. This effect will always be strongest in the layers constituting the governing class. This class is of paramount importance in determining the real and apparent 'national character' and hence in controlling racial evolution. In its origin, like other groups, a governing class must in a sense be adaptive, that is to say, selected for its capacity to govern under the conditions prevailing at the time. Is it capable of maintaining its adaptability? The answer is that there are two main conditions operating to prevent it doing so.

The first is that groups within it are not highly inbred and specialized for their function. Among eminent churchmen (the most inbred profession in England) for the last fifty years only 25 per cent have been sons of churchmen, and the proportion who have married the daughters of churchmen is now even lower than that ("Who's Who", 1890–1940). From the mixture that is going on, segregation of unsuitable types is therefore likely to be more frequent than in the working classes. But the

inheritance of wealth (or power) gives a governing class the means, which it is bound to use, of releasing itself from selection pressure, of preventing its members taking their adaptive level. This effect is partly a cultural effect of family life, but it can be assisted by the development of such special educational barriers between classes as we find in England.

The second condition lies in the mechanism of social diffusion by which governing classes may be reinforced and their deterioration avoided. On one hand, diffusion between classes may be prevented. Then, not only are human individuals wasted but also genetic materials, useful to the race, are apt to be thrown away, since they are tested in the wrong environment. For a while, of course, such materials may accumulate until changes such as the English, French, or Russian Revolutions occur to make use of them. If, however, they are to be stored, as in India, for thirty or forty generations, these elements will be lost before they can be used. The social tension will be released and the system internally stabilized. The economic and professional castes of India temporarily broken by Buddhism and loosened by the Mohammedan invasion have been given by British rule an organic rigidity to which every process of ordered government, even the Census, contributes a stabilizing effect[15].

On the other hand, where social promotion occurs, at first sight it might appear that social merit must always be its chief agent. But just as a governing class in its origin is always mixed, so it will be in its reinforcement. To this process Fisher[16] ascribes the decay of governing classes and in turn the decay of the empires they govern. He suggests that social promotion of men is favoured by the reduced fertility of their parents, which has been shown to be heritable. This effect will be all the more important for exaggerating itself. But it is only a part of the story. The social promotion of women will always be based on qualities of a different kind from those favoured in the promotion of men and often conflicting with them. Its effect will be predominant where the governing class is legitimately polygamous. We may, therefore, see in the excessive fertility of sultans and emirs a process contributing to the rapid decay of Islamic cultures.

Thus class division combined with diffusion are necessary for the efficient utilization of the race where the differentiation of the culture is stable; but the conditions of diffusion, unless suitably controlled, may make it little better than no diffusion at all.

Conflict of Systems

If mankind had long been broken up into genetically isolated fragments it would at once be obvious to us that race made culture and language. Any group, however heterogeneous, would have to be held genetically responsible for its aggregate cultural activities. Now both races and culture are continually being mixed, but culture is a more important obstacle to this mixing than race. Hence the relationship becomes reciprocal. Culture and language often make race just as much as race makes culture and language. It is this argument, combining genetic premises with a dialectical change, which has hitherto defeated historians and philosophers.

When languages are mixed or transferred the process is always selective. In Burma social advancement is often the incentive and tribes "change their language almost as often as they change their clothes"[14]. The same principle applies in the West. Owing to the dominant cultural influences of certain Western languages, English, French, German, Spanish, Swedish, Russian, Turkish, Persian, minor language and dialect groups have at various times become socially and culturally depressed. Where the depressed group has held on to its language in spite of this, it has by social diffusion lost genetically useful elements to the dominant group. In recent times we have seen the resurrection of such depressed and genetically extracted classes as nations, and the artificial result has sometimes been disappointing. A similar genetical extraction and depression has commonly benefited the town at the expense of the country and the capital at the expense of the provinces. Again, where a caste system is fixed, as in India, this extraction is prevented to the common disadvantage.

When conquest breaks down a mating barrier, and races fuse, outbreeding momentarily succeeds inbreeding with results which historians again have found hard to explain. The most instructive of these changes is that accompanying the expansion of Islam, for here the same experiment was repeated, extending in time over a thousand years, and in place from Marakesh to Delhi. The choice Islam offered to the vanquished with varying emphasis was a simple one: exogamy or death. The result was nearly always the same. New genetic combinations were able to take advantage of new cultural combinations and a striking cultural development took place, although limited for the reasons we saw to seven or eight generations. This effect was due to the breakdown of class as well as race barriers assisted by polygamy. The conversion to Christianity, on the other hand, had no such striking cultural consequences, because it did not destroy the existing mating barriers established by class or by race.

Polygamy thus affects both class structure and sexual selection; and sexual selection is biased by changing social conditions. The two sexes must always be complementary in reproductive function but otherwise their adaptations are, genetically at least, as different as those of two closely related species. Karl Pearson[17] showed how the average cranial capacity of different races differed and how the proportions of male to female also differed. His summary led him to the conclusion that in the older civilizations which were closer to a matriarchal stage of development, women's cranial capacity was relatively larger than in modern civilizations. Whether or not this inference is sound we cannot help assuming that human history has been a process of intellectual specialization of the two sexes which for the reasons we have seen will have led to different results in different races and classes.

The historic change from matrilinear to patrilinear inheritance has also led to important conflicts. In all groups of mankind exogamy rules have probably existed at one time. Marriage has been forbidden within certain degrees of relationship, real or imaginary. The system has reached its highest development in the sparsest and therefore most inbred communities, as in Australia[18,19].

The exogamy rules often break down. They do so especially when the inheritance of property develops during an unresolved conflict between matrilinear and patrilinear inheritance. The result is an instruc-

tive experiment. In the Ptolemies, successful incest began after a half-cousin marriage. In the whole line of thirteen, eight had full brother-sister marriages, but only three were fruitful. No two of these were in successive generations. The legitimate inbred line died out and Cleopatra's mother is unknown[10]. Similarly in Peru only one of the royal Incas is known to have been the issue of a brother-sister marriage. In neither case was there any continuous incest[11].

Successful and regular incest, on the other hand, has frequently been maintained by half-sister marriage, for example, in the Eighteenth Dynasty in Egypt[10]. Such marriage was common also in ancient Athens and among the Mongols and it occurred in Ur and in the royal house of Siam. The practice is no doubt helped by half-sisters being very numerous and also by the action of the matrilinear incest taboo. The evidence of experimental breeding in turn makes sense of this taboo. Only in five generations of self-fertilization and in ten of brother-sister mating will sterility usually wipe out the inbred stock. The effect will be most drastic when inbreeding is suddenly introduced in an outbred stock, and the inbreeding must be continuous to be cumulative. The exogamy rules of man like most moral laws seem, therefore, to have been derived by an extreme extrapolation. Incest is directly dangerous to the progeny only under special conditions which have nothing to do with those governing the indirect effects of inbreeding on a whole group.

The group effect of inbreeding is that it gives homogeneity, predictability of offspring from parent, rapid adaptation, easy transmission of culture, sometimes too easy, and hence potential stability of culture. It is a conservative agent and it conserves itself best in the most conservative peasant communities. It opposes initiative. It reduces conflict, sometimes disastrously. If applied to specialized classes it conserves their differences and increases their fitness. In India the endogamous caste system has preserved a store of variation which, if released by free crossing or recombination, might well enable us to reconstruct the whole genetic range of mankind.

On the other hand, inbreeding, while increasing temporary fitness, reduces flexibility. It reduces the means of acquiring fitness to new conditions. The Andaman Islanders steadily decreased in number from 4,800 in 1858 to 460 in 1931[15]. This is said to be due to the deleterious effect, either of inbreeding, or of the contact of civilization with a primitive people. It would be more accurate to say that it was due to a homogeneous race being confronted with conditions to which it was not adapted. Homogeneity provides the optimum condition for epidemic. Heterogeneity permits selective survival and recovery.

This advantage of heterogeneity merely shows in a special way how inbreeding frustrates the long-term function of sexual reproduction, the recombination of genetic differences, recombination which cannot take effect without the combination of these differences by outbreeding.

The long-term function of outbreeding has moreover come to imply a short-term advantage. Species become adapted to outbreeding and the adaptation, as we saw in regard to incest, cannot be overridden without risk. This adaptation has been explained in general polygenic terms by Mather[7]. His explanation is all the easier to apply owing to the probable importance of super-genic differences arising through inversions of groups of genes. These are more likely to favour the heterozygote than are single gene systems since they cannot be broken up by recombination in the heterozygote. The equilibria of blood group and taste genes which seem to have persisted in man since before his separation from the apes[12] suggest such a favouring of heterozygotes.

Hybrid vigour might be expected to be shown in these circumstances. Dahlberg[13] attributes the increase of average height of recruits in Sweden by 9 cm. to the increased outbreeding following increased mobility. The change is steady over a hundred years and cannot, therefore, be due entirely to improved nutrition. We are accustomed to regard such a change, which is noticeable also in England, as advantageous, and that may be so. But if the previous range of heights was an optimum, secured by adaptation to conditions which have not changed, we must now be too tall. Thus there is a conflict between the advantages and the disadvantages of outbreeding at both genotypic and phenotypic levels and as between the short view and the long one.

How then is this conflict to be resolved? In general the combination of inbreeding and outbreeding in parallel rather than in sequence gives the greatest efficiency in the utilization and selection of the available variation of mankind and, consequently, the most rapid evolution. A subdivision of mankind into races and classes is, therefore, highly advantageous provided that we can assure its instability. This seems to be no insuperable difficulty at present. The rapidity of differential population changes, the increase of mobility, the changes of methods of production, and the technical requirements of government, have upset the stability of races and classes as well as the adaptation which partly justified that stability. In these circumstances the 'young' peoples newly derived from a mixing of races or of classes have obvious advantages over the most permeable of stable societies yet known. Outbreeding for the moment is in the ascendant because cultural evolution is increasing its pace; and this again is a reciprocal and therefore self-exaggerating effect.

Conclusion

Man's intellectual and cultural evolution has led not to an absence of the races found in other species but merely to a special character in these races, due we may say to a special combination of artificial and natural selection. He uses a cultural and intellectual discrimination in the subdivision of his mating groups which must artificially accelerate his evolution. His habits of migration and conquest, on the other hand, continually constitute new groups of hybrid origin. These must therefore be, for most of their lives, groups, not of decreasing, but of increasing homogeneity. The common posterity, rather than the common ancestry, is what matters in human races and classes. Moreover, these groups are not classified by marker genes. For all these reasons human races and classes are more homogeneous than they seem; animal breeds, by contrast, less so.

We must, therefore, regard those who would have us shut our eyes to the genetic differences between races and classes, lest the recognition of unlikeness should generate antagonism, as offering us the counsel of timidity and escape. Let us rather consider that all the races and classes of men, however distinct, and usefully distinct, are likely in the end to have their posterity in common and to the common advantage; and that this posterity will still be classified and subdivided. Meanwhile, let us use the

methods at our disposal for evaluating the different genetical and cultural prospects of different races and classes and systems of mating. In doing so we shall recognize the reciprocal connexions that exist between changes in the mating system, the economic system and the political system. For in changing one we are likely to change all three, and the systems which are functionally the most advantageous have a prospect of being eugenically the most desirable.

[1] Trench, R. C., "On the Study of Words", 19th ed. (London, 1886).
[2] Darwin, C., "The Descent of Man" (London, 1871).
[3] Baur, E., Fischer, E., and Lenz, F., "Menschliche Erblichkeitslehre" (Munich, 1923).
[4] Huxley, J. S., and Haddon, A. C., "We Europeans" (London, 1935).
[5] Toynbee, A. J., "A Study of History", 1 (Oxford, 1934). cf. Benedict, R., "Race and Racism" (London, 1942).
[6] Wright, S., *Genetics*, **28**, 114 (1943).
[7] Mather, K., *Biol. Rev.*, **18**, 32 (1942).
[8] Keith A., *J. Roy. Anthrop. Inst.*, **46**, 1 (1916).
[9] Haldane, J. B. S., *Proc. Roy. Inst.* (1931).
[10] Boyd, W. C., *J. Phys. Anthrop.*, **27**, 333 (1940).
[11] Dudley, F. C., and Allan, W., *J. Hered.*, **33**, 331 (1942).
[12] Hogben, L., "Genetic Principles in Medical and Social Science" (London, 1931).
[13] Dahlberg, G., *Genetics*, **14**, 421 (1929).
[14] Haldane, J. B. S., *J. Genetics*, **36**, 213 (1938).
[15] Indian Census Report, 1931, Vol. 3, Ethnographic. (Delhi.)
[16] Fisher, R. A., "The Genetical Theory of Natural Selection" (Oxford, 1929).
[17] Pearson, K., "The Chances of Death" (London, 1897).
[18] Karandikar, S. V., "Hindu Exogamy" (Bombay, 1929).
[19] Jolly, A. T. H., and Rose, F. G. G., *Ann. Eugenics* (in the press, 1943).
[20] Ruffer, M. A., "Studies in the Palæopathology of Egypt" (Chicago, 1921).
[21] Markham, C., "The Incas of Peru" (London, 1910).
[22] Fisher, R. A., Ford, E. B., and Huxley, J. S., NATURE, **144**, 150 (1939).
[23] Dahlberg, G., "Race, Reason and Rubbish" (London, 1939).

A MIOCENE ANTHROPOID MANDIBLE FROM RUSINGA, KENYA

By DR. L. S. B. LEAKEY

Coryndon Museum, Nairobi

IN September 1942, during a brief period of leave from my war-time duties, I was able to revisit the Miocene fossil beds on Rusinga Island in the entrance to the Kavirondo Gulf of Lake Victoria. During my stay on the island, I had the good fortune to discover a nearly complete anthropoid mandible *in situ*. This was removed in its matrix to the Coryndon Museum, Nairobi, and there developed.

The Rusinga Miocene fossil beds were studied by my third East African Archæological Expedition in 1931–32, and again in my fourth expedition in 1934–35. On both occasions collections of fossils were made which included anthropoid material, and on the second occasion, in 1935, the expedition geologist, Dr. P. E. Kent, made a special study of the fossil beds from the stratigraphical point of view, and of their relation to other Miocene beds in Kenya.

The new mandible now discovered in these Rusinga Miocene beds is by far the most complete anthropoid specimen yet found in Kenya, and is of special importance. It has the whole of the symphyseal area preserved intact as well as the left condyle and coronoid. A detailed study of the above specimen as well as many other less complete Miocene anthropoid fossils from Kenya has now been prepared by Dr. McInnes[1]. The object of the present communication is to give a preliminary account of certain features of the new fossil, so as to enable those who are interested to order reprints of the more detailed paper.

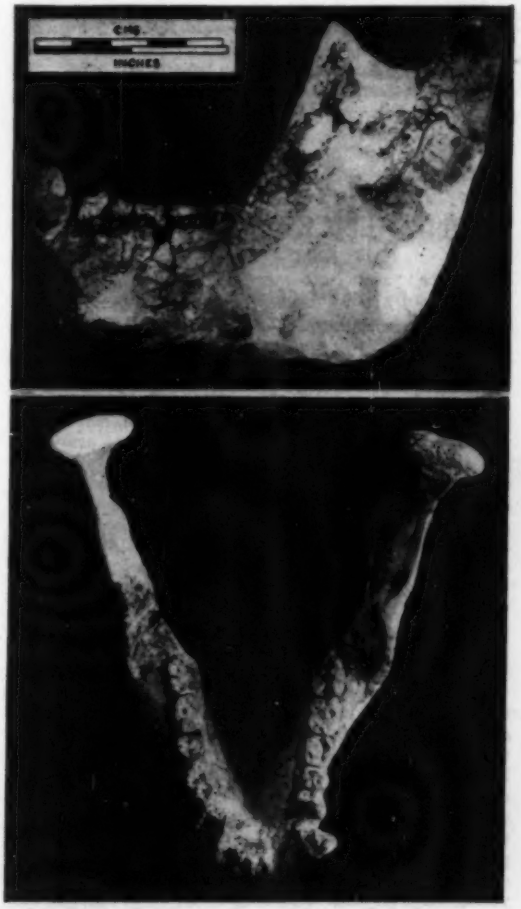
The characters which appear to be of special importance are :

(1) There is no simian shelf such as is seen in modern apes and also in Dryopithecus. The most backward point of the symphysis is in the region of the genial tubercles as in man. From this point the symphysis bends forward again much as in man, instead of having a backward projection from a genial pit as in the great apes.

(2) The premolars are much reduced in size.

(3) The first and second molars are wider posteriorly (distally) than anteriorly (proximally). This feature is associated with a shortening of the molar premolar series, indicative of a reduction of the muzzle-length and probably a more vertical face than in living great apes.

(4) The ascending ramus is relatively high and



MIOCENE ANTHROPOID MANDIBLE FROM KENYA.

wide compared with the size of the corpus and the area of the chewing surface.

(5) The molar-premolar series are remarkably convergent anteriorly as in man, and not parallel or convergent posteriorly as is usual in the great apes.

(6) The form of the condylar process approximates more to that seen in man than to that in the living apes. Unfortunately, this part of the mandible is unknown in any other fossil ape.

(7) Viewed from the front, the mandible has a certain general resemblance to the human form.

(8) The flat wear of the molars is reminiscent of that seen in Eoanthropus and man rather than the type of wear seen in the great apes. On the other hand, the canine is large. The third molar exhibits the typical Dryopithecus pattern of the cusps, and the premolars, though reduced in size, are more anthropoid than human in character.

This new mandible is assigned to the genus Proconsul originally described by Dr. A. T. Hopwood from fragmentary material from Koru, Kenya, but it does not seem to bear out his interpretation that "the genus is ancestral to the chimpanzee", but rather supports and gives added point to the view expressed by Drs. Gregory and Hellman, that Proconsul stands "near to the common ape-man stem".

I would like to express my thanks for the comments sent to me by Sir Arthur Keith, Prof. Le Gros Clark and Dr. W. K. Gregory as a result of notes and photographs sent to them soon after the discovery was made.

[1] *E. African Nat. Hist. Soc.*, Nairobi, Kenya (In the press).

CONFERENCE ON THE FUTURE OF ARCHÆOLOGY

By KATHLEEN M. KENYON

Acting Director, Institute of Archæology, University of London

AT the present time, the thoughts of many people are turning to the problems of the post-war period. Many of these problems are material and in the economic sphere, but equally important are those in the cultural and educational sphere. Some archæologists have been considering in what way and by what means archæology is going to make its contribution to the post-war period, and during August 6–8 a conference on the Future of Archæology was held at the Institute of Archæology of the University of London, at which some 280 people were present, including most of the leading archæologists at present in the country.

The dominant theme was that archæology, as Mr. W. J. Varley expressed it, was no longer the pursuit of a very recondite erudition by a select few in a quiet temple dedicated to no other purpose. It was a study which could clothe the past with reality, through which man can achieve what is essential if he is to survive, a sense of community with all other men in the world of space. Dr. Grahame Clark, who opened the conference with a paper on the "Contribution of Archæology to the Post-War World", put the claim of archæology to be of value to everyone, in his statement that it not only gave to old and young alike an understanding of the birth and growth of culture in their own lands, but it also provided a basis of common understanding between men of all nations, since the early history of mankind in the Palæolithic period, for example, formed a common heritage of all men.

Prof. V. G. Childe, in a stimulating paper on the "Unity of Archæology", stressed again this same point. The different branches of archæology had grown up by varied means. Classical archæology, due to its antiquarian ancestry, had developed from a search for monuments, coins and inscriptions. Mesopotamian archæology was originally interested almost entirely in tablets and sculptures, while prehistoric archæology, owing to the lack in this sphere of more spectacular relics, was compelled to devote attention to everyday objects, and the way of life of the common man. Gradually, however, all branches were coalescing and making as their common aim that of recovering and reviving the life of societies of the past from their concrete remains, and to do this all branches were borrowing methods from the others. A unity of approach was highly important, since archæology alone can tell how and in what directions humankind has progressed. Written history is too brief, and only archæology can survey men and their achievements over half a million years in every corner of the globe.

The problem next in importance to be discussed was how archæology, granted thus to be important to all, could be placed before the public in an interesting and palatable form. In a session devoted to "Archæology and Education", the different ways that the subject could be introduced into elementary, secondary, university and adult education were discussed, and the matter came in again in the session on "Museums and the Public". Archæology, through reconstruction and visible remains, can make local history live both to children and adults, and the child who could see actual Roman leather shoes, and the British workman who could carry through voluntarily an arduous excavation in order to see what sort of a job his Iron Age ancestor had made of digging a rock-cut ditch, were gaining something which no amount of lessons or lectures could give. Many illustrations were given of the widespread interest there is in the concrete history of the past. To meet this, archæologists must be prepared to popularize their science. All teachers of history, geography and art should have a grounding in archæology, and something should also be done to bring home to men of science that life is not all atoms and formulæ, but that some kind of historical knowledge or understanding is essential to make them educated men and women.

Other sessions were devoted to the actual problems, both archæological and of organization, of the future. Speakers outlined the problems needing attention in the different fields. Both Britain and the Near and Middle East were covered by a number of papers, and detailed suggestions of needs for the different countries were made, while during the discussions, emphasis was laid on the fact that areas such as Central Asia, the Far East and South America should not be neglected. A very special problem was set by the opportunities given by war damage for the examination, before reconstruction, of sites both in Britain and the Mediterranean area, and adequate provision for this must be made. The need for planning was continually referred to, but Mr. J. N. L. Myres made the very important point that planning must be elastic and must neither curb individual initiative nor regiment research.

In all the addresses there kept recurring the view that, in the conditions to be expected in the post-war period, archæology would be financially in a difficult position. Though some speakers felt that security was undesirable, and that archæologists were the more devoted from having to stump the country raising funds, as did Sir Flinders Petrie, the general consensus of opinion was that unless some reasonable prospect of a livelihood was held out many promising students would be lost. The growing difficulties of archæological societies were pointed out by both Prof. Alan Gardiner in his comparison of the palmy days of the Egypt Exploration Society at the end of the last century with its present state, and by Mr. H. St. George Gray in his survey of the responsibilities and commitments of the local British societies. Many felt that some form of State assistance was both justifiable and necessary. Others, however, feared that any form of State assistance would involve State control, which might hamper the freedom of research. A solution advocated by Mr. Grimes, and supported by many, was that in connexion with some State organization co-ordinating the different bodies at present concerned with State archæology, there should be some form of grants, made through a responsible archæological body, which would ensure that research as such was adequately endowed, but free of officialdom. Sir Leonard Woolley put forward an eloquent plea for State support for British schools of archæology abroad, with the suggestion that these should be sponsored by the British Council. Other speakers supported his plea for strong British schools, though they deprecated any suspicion that archæology should be used as a means of official dissemination of British culture. Good relations would result from them, particularly if they were open to the nationals of the country in which they were established, but they would be a by-product of the main end, the furtherance of knowledge.

The other main subject discussed was the "Training of Archæologists". The point was strongly made that excavators must receive a sound training in field work. Archæologists in the past had mainly learnt from experience and experiment, usually at the expense in the early stage of a partial destruction of the evidence of an archæological site, and it must be realized, as Mr. I. A. Richmond said, that Roman villas do not exist to provide a Roman holiday for amateurs. The need for training in the environmental sciences was stressed by Dr. F. E. Zeuner. Archæologically-minded geologists and biologists should acquaint archæological students with the processes or phenomena investigated by those sciences, in order that they may know how best to make use of the specialists.

The results of the Conference may thus be summarized: the setting out of the vital contribution which archæology can make to the education of mankind, and the means by which this can be achieved; the emphasis laid on the need for additional financial resources, and the suggestions as to how these should be forthcoming from the State; and the suggestions as to how archæologists should be trained. The Conference closed with a resolution that the problems should be referred to the appropriate bodies for action, those affecting Britain to the newly formed Council for British Archæology, and those affecting work overseas to the societies interested, with the suggestion that they should set up an appropriate organization to deal with them.

OBITUARIES

Prof. Frank Schlesinger

THE name of Frank Schlesinger will always be associated with the determination of stellar parallaxes, for to him is mainly due the considerable knowledge of stellar distances that we now have. It was a fortunate circumstance that his postgraduate research was carried out at the Columbia University, where at the close of the nineteenth century astronomical research work was mainly concerned with the problems of the accurate determination of star positions by means of photography. The great possibilities that photography offered in this field were just beginning to be realized. Schlesinger's thesis for the Ph.D. degree was concerned with the accurate measurement and reduction of photographs of the Præsepe cluster, obtained by Rutherfurd, and showed originality of mind, a thorough grasp of fundamental principles, and ingenuity of method. He was quick to see the possibilities that photography offered for the accurate determination of stellar parallaxes. A short paper, published in 1899, entitled "Suggestions for the Determination of Stellar Parallax by means of Photography", referred to the neglect of this important subject and estimated that not more than twenty-five or thirty stars had known parallaxes which could be relied on to within 0·05″. It outlined methods which Schlesinger was himself afterwards to develop, and showed that he already clearly saw the main precautions that were needed to obtain accuracy.

A few years were to elapse, however, before Schlesinger could try out the suggested methods. He was appointed in 1899 to take charge of the newly established International Latitude Observatory at Ukiah, Ca., but the opportunity came with his appointment in 1903 to the staff of the Yerkes Observatory. He at once started parallax observations with the great 40-in. refractor. In a remarkably short time he developed methods that have since been closely followed by every observer who undertakes the determination of stellar parallaxes. In 1905 Schlesinger was appointed director of the Allegheny Observatory, which had just been reorganized, and for a time his attention was devoted to other problems, mainly of a spectroscopic nature. The results of the work at Yerkes were published in 1910–11 in seven important papers, which have deservedly become classics in this field of investigation. The methods of observation, the possible sources of error and how they could be eliminated or reduced to a minimum, the methods of measurement and of reduction were all comprehensively discussed. For the measurement of the plates Schlesinger designed an excellent long-screw measuring engine, which was made by Brashear. Many other engines of the same design have since been made by Gaertner.

It was characteristic of Schlesinger, when planning large programmes of observations, to consider carefully the accuracy attainable in relation to the expenditure of time in observation and measurement. There is generally a point beyond which further accuracy can be obtained only at the expense of a disproportionate increase in time and labour. As an example, Kapteyn had proposed that parallax plates after exposure should be stored undeveloped for six months or so and then exposed again, so that the parallactic displacement could be determined by differential measurements and the effects of film

distortion eliminated. The method involved considerable wastage of material, because ideal conditions at the two epochs could never be obtained, and there were also many possibilities of plates being spoilt by accidents of one sort or another. Schlesinger thoroughly investigated film distortions and proved that their contribution to the final probable error was so small that the slight gain in accuracy was outweighed by the wastage of material and the other disadvantages of the method.

The observations in his short time at Yerkes enabled Schlesinger to determine twenty-eight parallaxes, with an average probable error of $\pm 0{\cdot}013''$. In 1914, on the completion of the Thaw 30-in. photographic refractor, he started parallax work at Allegheny. In six years he determined 365 parallaxes and obtained plates for several hundred additional ones: the probable error of these parallaxes was about $\pm 0{\cdot}008''$. He also arranged a carefully planned scheme of co-operation between the seven Observatories of Allegheny, Dearborn, Greenwich, Leander McCormick, Mount Wilson, Sproul and Yerkes. In 1924 he published a "General Catalogue of Stellar Parallaxes", containing the parallaxes of 1,870 stars, all but a few of which were the outcome of this scheme of work.

But this advance in knowledge was restricted to the northern portion of the sky, and Schlesinger therefore began to consider the possibility of erecting a large refractor in the southern hemisphere to remedy the deficiency. In 1920 he was appointed director of the Yale Observatory and was able to bring these plans to fruition. A 26-in. refractor of 36 ft. focal length was set up in the grounds of the University of the Witwatersrand, Johannesburg. The telescope and its housing were designed for the specific purpose of parallax determinations; as the observations are always obtained near the meridian, the motion of this telescope in right ascension is limited to about half an hour either side of the meridian, thus reducing considerably the cost of the installation. Co-operation with the Cape Observatory was also arranged, and the output of these two Observatories has been so considerable that the deficiency of knowledge of parallaxes of southern stars has been made good. The second edition of the "General Catalogue", published in 1935, contains trigonometrical parallaxes of about four thousand stars; including parallaxes determined by spectroscopic methods, the calibration of which is based on trigonometrical parallaxes, it gives the parallaxes of 7,534 stars. The "Catalogue" is not a mere compilation; it is based on a careful critical discussion of accidental and systematic errors to ensure that the probable errors assigned to the individual parallaxes are statistically correct.

Schlesinger's other main work was the determination of star positions from wide-field photographs. The basic ideas were to lighten the burden on the meridian observer, by restricting meridian observations to the brighter stars, and to determine the positions of fainter stars more accurately as well as more economically by photography. Plates covering a large field were necessary to ensure that each plate should contain sufficient of the brighter stars to serve as reference points. Plans for a programme with a lens covering 25 square degrees were drawn up in 1915 and the positions of stars in three zones, each extending over 5° in declination, were determined. Schlesinger then changed to a lens of 5·6 in. aperture and a focal length of about 80 in., using plates measuring 48 cm. by 58 cm., covering an area of 10° in declination and 14° in R.A., with a scale of approximately 100″ to 1 mm. Somewhat later he substituted a more efficient lens of 5-in. aperture, with plates 43 cm. square, covering 112 square degrees. The wide-angle lens camera was mounted on the large refractor at Johannesburg for photographing the southern stars. The measurement and reduction of these large plates introduces a number of delicate technical problems which Schlesinger solved with consummate skill. As the programme proceeded, various modifications and refinements were introduced for greater convenience and accuracy. His latest catalogue, recently published, has probable errors of a catalogue position of $\pm 0{\cdot}105''$ in each co-ordinate. Since 1925 the positions of some 77,000 stars have been published, a remarkable achievement for a single observatory with a small staff, and a tribute to the efficiency of Schlesinger's methods.

Schlesinger received the honorary degree of Sc.D. from the Universities of Pittsburg and Cambridge. He was elected an associate of the Royal Astronomical Society in 1914 and was awarded its Gold Medal in 1927. He was awarded the Valz Prize of the Paris Academy in 1926 and the Bruce Medal of the Astronomical Society of the Pacific in 1929. His election as president of the International Astronomical Union for the period 1932–35 was a fitting climax to a career of solid achievement. He retired in 1941 but, though he suffered much ill-health in his last years, he continued his work on the zone catalogues to the end. He died on July 10, at the age of seventy-two. He was a man of great understanding, wise in counsel, loyal in friendship and trusted by all.

H. SPENCER JONES.

Mr. C. V. B. Marquand

CECIL VICTOR BOLEY MARQUAND, only son of Ernest David Marquand, author of a "Flora of Guernsey", was born at Richmond, Surrey, on June 7, 1897. He was educated at Elizabeth College, Guernsey (1906–10), Lycée Henri IV, Paris (1910–11), Bedford School (1911–13), and Christ's College, Cambridge, where he took his B.A. in 1919, proceeding to M.A. in 1922. During the War of 1914–18 he served in the Machine Gun Corps, and held a commission in the Royal Tank Corps, from which he was invalided out.

On leaving Cambridge in 1919 Marquand was appointed research assistant in charge of investigations on Avena at the newly established Welsh Plant Breeding Station, Aberystwyth, and published a paper on "Varieties of Oats in Cultivation" in the second Cereal Bulletin of the Station. This was undoubtedly a very useful piece of work, and supplied keys for the identification of all the varieties that could be got together at that time. In 1923 Marquand was appointed assistant (a title since changed to botanist) in the Herbarium of the Royal Botanic Gardens, Kew, and at first continued work on the grasses, but was soon placed in charge of the Chinese section of the Herbarium, and wrote numerous papers on the flora of Eastern Asia, including revisions of the campanulaceous genus Cyananthus (1924), the Old World species of Buddleia (1930), and the gentians of China (1937). He was also interested in the genus Cotoneaster, many species of which are cultivated in Great Britain. He had charge of the Bryophyta (mosses and liverworts), a group which he had

always found very attractive, but his other official work naturally left but little time for its study. He combined a passion for mountaineering with a great love of wild Nature, and was an enthusiastic field-botanist, many of his happiest days being spent in bryological holidays in the Alps, the Scottish Highlands, and North Wales. His ecological interests were reflected in a paper on the Bryophyta of Arctic-alpine associations in Wales (1922), and he continued to take a keen interest in genetics during his period at Kew, though he published nothing further on the subject.

Though Marquand was physically very vigorous, his constitution seems to have been permanently affected by his service during the War of 1914–18, and he retired from Kew in 1939 on account of ill-health. He then went to live in the island of Skye, where he was able to devote himself to field-work on the Lower Cryptogams. His tragic death last June on a boating expedition in search of a rare alga came as a great shock to his many friends. Generous, and incapable of a mean action, Marquand was a pleasant companion on a botanizing expedition, which his wide range of interests, not to mention his very decided views, helped to cheer and enliven.

T. A. SPRAGUE.

WE regret to announce the following deaths:

Dr. H. G. Baynes, an authority on Jung's system of analytical psychology and author of "The Mythology of the Soul", on September 6, aged sixty-one.

Capt. F. O. Creagh-Osborne, C.B., formerly director of the Compass Department of the Admiralty, on September 1, aged seventy-six.

Sir Francis Fremantle, O.B.E., M.P., an authority on public health, on August 26, aged seventy-one.

Dr. Aleš Hrdlička, head of the Division of Physical Anthropology in the U.S. National Museum from 1910 until 1942, on September 5, aged seventy-four.

Lady Lockyer, widow of the late Sir Norman Lockyer, founder of NATURE, on September 9, aged ninety-one.

Dr. W. H. Metzler, formerly professor of mathematics in Syracuse University, on April 19, aged seventy-nine.

Sir James Morton, a pioneer in the British textile industry, on August 22, aged seventy-six.

Dr. Cecil Price-Jones, the authority on the sizes of blood cells, on August 29.

Prof. L. Susan Stebbing, professor of philosophy in the University of London (Bedford College), on September 11, aged fifty-seven.

NEWS and VIEWS

Ophthalmological Research at Oxford

AN appeal for £250,000 has recently been launched by the University of Oxford to endow a Research Department in Ophthalmology. The only other university department of this character in Britain at the present time is the Tennant Research Institute at Glasgow, though the Royal Eye Hospital, in conjunction with the Royal College of Surgeons, has recently founded a research chair in ophthalmology. In 1940 Lord Nuffield gave £25,000 to enable the University of Oxford to build a small temporary laboratory for the new reader in ophthalmology and to appoint a research biochemist. This laboratory has been open for a year and work on nutritional and other problems has been started. In 1941 the total blind population of England and Wales was 70,000. Although four and a half million pounds was spent on their welfare during that year, the amount spent on prevention was comparatively small. Apart from blindness, it is perhaps not generally realized how widespread are defects of vision in the population. In 1937, nearly one sixth of the school children medically examined were found with "defective vision and squint". The children in London had a higher proportion of defects than those outside. Recent study of orthoptics justifies the hope of advancement in the relief of these defects in children and emphasizes the need for more work along these lines.

Advances in the science of nutrition have shown that a large amount of preventable blindness occurs in countries where the standard of life of the population is low. For example, deficiency in vitamin A leads to much blindness in children in Ceylon. Although such acute vitamin deficiencies do not occur in Europe, the effect of prolonged sub-optimal nutrition on the eyes must be investigated. Another problem to be examined is the question of illumination in factories and elsewhere. Defective illumination is responsible for many industrial accidents, as well as causing eye-strain among workers, resulting in diminished output. These examples show that what is needed at the present time is collaborative research between the ophthalmologist and research workers in experimental sciences. The department which the University of Oxford hopes to establish will provide facilities for such studies. Oxford is a peculiarly suitable home for such a department, as it already has an eye hospital which has a tradition of research, and collaboration between the medical and non-medical sciences is well established.

Research on Coal

THE colliery owners of Great Britain will provide a further sum, of the order of half a million pounds, for coal research, in order to extend their existing programme, which itself involves the expenditure of £1,000,000 over the current five years. It will be recalled that the Parliamentary and Scientific Committee recently urged a great expansion of utilization research into coal derivatives, adding that although the work should be generously subsidized by the Government, it should be carried out by industry itself. The new programme now announced by the Mining Association of Great Britain relates to the development of processes for producing hydrocarbons and hydrocarbon derivatives from coal, and to the treatment of coal generally as a chemical raw material. It will be put in operation immediately, and the colliery owners will themselves contribute £400,000–£500,000 towards its cost during the period ending with 1945.

Coke and Coal Research

THE investigations of Prof. H. L. Riley at King's College, Newcastle-upon-Tyne, and also those of Dr. R. A. Mott at the University of Sheffield, are concerned with problems affecting the hard coke industry,

which enjoys facilities for large-scale experimentation through its member firms such as can only be available to industrial bodies of this kind. The research committee of the body organizing this work visited the Kingston and Fulham Laboratories of the British Coal Utilisation Research Association on September 9. Mr. J. G. Bennett, director of B.C.U.R.A., gave a short address, outlining the organization of his Association and the scope of the work it has in hand. Three main divisions can be distinguished, namely, the administrative, the general research division, and the specialized research departments, the latter subdivided into four or five sections. Within several of the specialized sections there are investigations in progress which will undoubtedly affect coke-oven practice and the quality of the coke that can be produced from a given coal or blend. In particular may be mentioned the 'heat-of-wetting' test developed in the Association's physico-chemical laboratory under Dr. D. H. Bangham. This, and other fundamental work on the structure of coal and coke, was discussed at the recent Conference on the Ultra-Fine Structure of Coals and Cokes held at the Royal Institution. The visitors spent most of their time at Kingston, where they inspected work on the production of high temperatures from solid fuel and other interesting aspects before proceeding to the main building recently opened by Sir Edward Appleton.

Otto Jespersen and an International Auxiliary Language

EARLY this year Prof. O. Jespersen died in Copenhagen. He was a philologist of world-wide reputation who specialized in the English language, was the author of various standard works, and a firm believer in the practicability of an international auxiliary language. His work in this connexion has been ably summarized by H. Jacob in a brochure published by the International Language (Ido) Society of Great Britain, in which we read of Jespersen's active part in elaborating Ido as a revised version of Esperanto, and of his subsequent invention, in 1928, of a new constructed language, called Novial. He was convinced that an international auxiliary language should be based on the material of European languages, should be regularly constructed, have a complete grammar of its own, be flexible and independent of national usages. He emphasized how incomparably easier it is to learn and use such a constructed language than any ethnic language, a view that has been confirmed as the result of a six-years' test by Prof. Thorndike in the United States. English he regarded as easier than other languages, but it would have to be drastically altered, in regard to spelling, grammar, etc., to make it sufficiently simple for international use. Nor has Jespersen any use for Pidgin English: "it would be laughed at and mocked at, and all those millions who know and love the old English language would not consider it a serious attempt to solve an important problem, but would turn away with horror". The attempt to make English an international auxiliary language by reducing the vocabulary is held by many to be invalidated by the many different meanings which some words possess; thus the "New English Dictionary" ascribes sixty-four distinct senses to 'give', sixty-three to 'take', and twenty-five adjectival senses to 'clear'. As the outcome of a life-long study of linguistics, Jespersen believed that language is moving towards ever greater simplicity and perfection; and he quoted Turgot's saying: "Des hommes grossiers ne font rien de simple. Il faut des hommes perfectionnés pour y arriver". This Ido publication can be recommended to all interested in the subject, and especially as it shows no unreasonable bias in favour of its own language.

Centenary of the *Economist*

THE centenary number of the *Economist* worthily maintains the tradition of impartial examination of public affairs which it has established from the days of James Wilson and Walter Bagehot. The factual approach, acute analysis, constructive criticism and the flair for asking the right questions which have characterized it from the start are faithfully reflected in the pages of the centenary issue. Few periodicals can have done more to stimulate the consideration of social and economic questions in the cool serious spirit of science, and it is fitting that in congratulating the *Economist* on the attainment of its centenary, men of science should put on record their appreciation of the contribution which that journal has rendered to the advance of science. In the centenary issue scientific workers will find the articles on "Enterprise and Efficiency", on the Middle East Supply Centre, entitled "An International Example", on nationalization and on "Active Citizenship" of particular interest, but scarcely less stimulating and suggestive is that on "Britain in the World" and the review of the first hundred years and of the policy of the *Economist* which open the issue.

Academy of Sciences of the U.S.S.R.

THE continuing activity of the Academy of Sciences of the U.S.S.R. is indicated in information recently received from Moscow. Two sessions of the Academy were held in Sverdlovsk last year, and another is being held in Moscow this month. All kinds of fundamental research are being maintained despite the urgent claims of war work. Although in the U.S.S.R. scientific workers are exempt from conscription, many volunteered for military service when war with Germany broke out. It is vigorously maintained that this is a "scientists' war", demanding the continuation of scientific research, and in the list of essentials for victory achievements in mathematics, physics and agriculture are given equally high priority with achievements in fields more immediately associated with war. At the forthcoming session, thirty-six new full members of the Academy and forty-two corresponding members will be elected. Among the candidates for election are Drs. Kharkov, Kirill, Sinelnikov and Leipunsky, who are known in Great Britain for their work at the Cavendish Laboratory, Cambridge, and also the polar explorers Vladimir Bize and Nikolai Yukov.

Earthquake in Japan

ACCORDING to radio reports from Tokyo, a serious earthquake took place in southern Japan during the afternoon of September 10. The area most affected appears to have been near Tottori, in which town half the buildings collapsed and more than 1,400 people may have been killed or injured. Tottori is some 100 miles north of Kobe where the earthquake was felt. The shock was also strong at Osaka. Around Tottori railway lines were blocked and telegraph communications were interrupted for a distance of 60 miles to the west. So far no news has been given concerning the area east of the town. Further news

is awaited, though it is doubtful in the present state of conflict whether full details of damage done will be available.

The last great shock from near the epicentre appears to have been some sixteen years ago, when 3,000 persons were killed. Earthquakes in the Japanese Islands are relatively frequent, and such as those of July 15, 1941, in the Nagano Prefecture, when thirty houses collapsed killing five people and injuring twelve more, and May 2, 1939, in the Akita district, when 573 houses were completely shattered and 1,218 damaged, killing twenty-six people and injuring twenty-eight others, are common. Most people, however, remember the great earthquakes of Kwanto in 1923, which almost destroyed Tokyo and Yokohama, Tango in 1927 and Idu in 1930, which were fully described by the late Dr. C. Davison. The instability of Japan is part of the instability of the whole of the circum-Pacific circle, though in the case of Japan the instability appears to be enhanced by the proximity of high mountains and great ocean deeps.

'Natural' and 'Supernatural'

In an article in the *Hibbert Journal* of April 1943, Mr. G. N. M. Tyrrell discusses the ideas which underlie the terms 'natural' and 'supernatural' and suggests that the emphasis so often laid on the words 'nature' and its derivatives is possibly due to a fear that what he calls 'supernature' may try to return. Pointing out that both in psychology and psychical research we find factors in personalities which have properties midway between those of conscious mind and unconscious matter, Mr. Tyrrell proceeds to say that it is now useless to try to defend an outmoded cosmogony in the face of scientific knowledge. The division between the natural and the supernatural must, he says, be discarded; what is wanted is a fuller appreciation of the fact that the question of objectivity and subjectivity is a question of how much or how little do we ourselves contribute to our own world. As Sir Arthur Eddington has put it, when referring to theoretical physics: "the mathematics is not there till we put it there".

Captain Thomas Sumner (1807–76)

Just a century ago the first edition was published of Sumner's "New and Accurate Method of Finding a Ship's Position at Sea", which contained the first description of the "position line" now universally used both at sea and in the air when navigating by the heavenly bodies. An article by R. S. Richardson (*Pub. Astro. Soc. Pacific*, 55, 136; 1943) contains some hitherto unknown biographical details of the man who so profoundly changed the methods of navigation. The facts have come to light as the result of a patient search by Dr. W. Van Lennep in the Harvard Library. Sumner was the son of a Boston architect and entered Harvard at the age of fifteen, three years ahead of Benjamin Peirce, later to become the professor of mathematics whom Sumner consulted regarding the merits of his method. At Harvard he studied mathematics and astronomy under John Farrar. Graduating in 1826 at the age of nineteen, he proceeded to sow his wild oats to such effect that in 1829 he found it advisable to enlist as a common sailor in the China trade. Within eight years he had risen to the rank of captain and was master of his own vessel. In 1837 he made the famous journey during which he discovered in dramatic fashion the principle of the position line. After six years presumably spent in testing the method and preparing the MS. of his book, he finally published the work in July 1843. It won instant recognition. It was supplied to every vessel in the U.S. Navy in the year of publication, and ran through several editions in the next decade. During this time, however, Sumner's mind was failing. In 1850 he was committed to a Boston lunatic asylum; in 1855 he was "hopelessly deranged"; and in 1865 he entered the Lunatic Hospital at Taunton, Mass., where he died of apoplexy at the age of sixty-nine, having spent in mental darkness the last twenty-six years of a life full of early promise. No doubt the tragic circumstances of his later life are sufficient explanation of the fact that the standard biographical dictionaries do not record so much as the dates of his birth and death.

Colonial Economic Advisory Committee

The Secretary of State for the Colonies has set up a Colonial Economic Advisory Committee to give him advice on matters of general economic policy in the Colonial Empire. The members of the committee are: The Duke of Devonshire, Parliamentary Under-Secretary of State (chairman); Mr. G. I. M. Clauson (vice-chairman); Lord Hailey; Sir Bernard Bourdillon; Sir William Goodenough; Sir John Hay; Sir Hubert Henderson; Sir Harold Howitt; Mr. A. Dalgleish; Mr. E. F. M. Durbin; Mr. J. Hallsworth; Mr. J. McFadyen; Mr. J. McLean; Captain B. H. Peter; and Prof. L. C. Robbins. The terms of reference are: "To advise the Secretary of State on such questions of economic policy in relation to the Colonial Dependencies as he may refer to the committee, including particularly matters of general policy arising on programmes of economic development."

B.B.C. Broadcasts on Applied Physical Science

The British Broadcasting Corporation is arranging a series of twelve weekly talks beginning on October 1 under the title "Science at your Service", on applied physical science. An attempt is to be made to bring before the layman the numerous ways in which physical science is being used in everyday life and to show that an understanding of the principles of science is essential in the post-war world. The addresses will deal with the home, building construction, plastics, clothing and fabrics, explosives, the structure of the earth's crust, the weather, planning fisheries, life-saving at sea, shipbuilding and tunnelling. It is expected that the speakers will include Sir Lawrence Bragg, Sir Edward Appleton, Sir George Burt and Sir Charles Darwin.

Industrial Health and Disease

A week-end course for medical practitioners on factory medical services and industrial diseases will be held at the London School of Hygiene and Tropical Medicine during October 2–3. The course will be opened by Dr. E. R. A. Merewether, senior medical inspector of factories, and lectures will be given on the clinical approach to industrial medicine, occupational pneumoconioses, anæmia in war-time, nutrition and vitamins in war-time, prevention of industrial dermatitis, and rehabilitation with special reference to minor injuries. The fee for the course is one guinea, which should reach the secretary of the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.1, not later than September 27.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Inhibition of Urease by Penicillin

IN treating patients with penicillin, our interest has been attracted to the problem of assay of the drug. Difficulties in this connexion are attached to clinical as well as laboratory studies, since it would be of considerable assistance in formulating principles for therapy to be able to measure small, sub-bacteriostatic quantities in the circulating blood. An attempt has therefore been made to discover easily measurable properties of penicillin, and we have found that even highly purified preparations will inhibit the activity of urease.

It has been necessary in this laboratory to work with macro-methods—a technical limitation that has compelled us to employ quantities of drug far in excess of the minimum producing bacteriostasis. Inasmuch as penicillin is extremely valuable and difficult to obtain, we have not attempted to study in detail the quantitative relationships involved.

Urease (Squibb) was prepared as 0·05 per cent solution in phosphate buffer, *p*H 7·3, and 1 ml. was used for each test. Penicillin in the uniform volume of 0·25 ml. water was added to the enzyme solution and the mixture allowed to stand for two hours at 37° C. Urea was made up as a 6 per cent solution in phosphate buffer, *p*H 6·4. 5 ml. of the same buffer was added to the final test solution to bring total volume to 6·75 ml. Urease activity was measured by the aeration method of Van Slyke and Cullen, as ammonia liberated in thirty minutes at room temperature from 30 mgm. urea.

Results of representative experiments are given in the accompanying table. For the most part, a commercial preparation (Merck) containing about 200 Oxford units per mgm. was employed. A large part of this material was composed of impurities which might well have accounted for some of the inhibition obtained. Indeed, attempts to demonstrate alteration in activity after forms of chemical and physical treatment known to destroy bacteriostatic agents produced effects that could not be clearly interpreted. A decrease in the degree of inhibition did occur after acidification, alkalinization and heating; but since the nature and variety of the impurities was unknown, this proves little with respect to the bacteriostatic agent. Of considerably more significance is the fact that a pronounced effect was obtained with samples of highly refined barium salt of penicillin*. This material contained 850 units per mgm. and was thus more than four times as pure as the Merck penicillin. In terms of amount of bacteriostatic agent, both preparations displayed about the same degree of inhibition of urease. On the other hand, the absolute weight employed was in one case 2 mgm. and in the other 7·5 mgm. This may be taken as evidence that the inhibitory activity is largely independent of impurities present.

EFFECT OF PENICILLIN ON ACTIVITY OF UREASE.

Experiment No.	Penicillin units	NH_3 liberated (mgm.).
1	0	0·63 in 30 min. at room temp.
	500 (Merck)	0·49 " " " "
	1000 (Merck)	0·25 " " " "
2	0	0·62 " " " "
	2000 (Merck)	0·27 " " " "
	2000 (Merck) (autoclaved 120°, 3 hr.)	0·55 " " " "
3	0	0·84 " " " "
	1500 (Merck)	0·30 " " " "
	1500 (Merck) (Kept at *p*H 2 and 37° 1 hr., then neutralized)	0·48 " " " "
	1500 (Merck) (Kept in *N*/10 alkali 1 hr., then neutralized)	0·65 " " " "
4	0	0·83 " " " "
	0 (Containing $BaCl_2$ 2 mgm.)	0·92 " " " "
	1700 (Purified Ba salt)	0·40 " " " "
5	0	0·78 " " " "
	1700 (Purified Ba salt)	0·34 " " " "

It would appear that final proof of the action of the bacteriostatic agent in this respect must await the ultimate stage of refinement of penicillin. Meanwhile although speculation with regard to the significance of these observations is perhaps premature, it may at least be pointed out that the peculiar elevation of blood-urea occurring in some patients under treatment with the drug[1] becomes of direct interest. For there is no clear analogy here to familiar clinical disorders that are characterized by urea retention. The absence of albuminuria and the prompt fall in the level of blood-urea upon withdrawal of penicillin argue against a disturbance of the excretory mechanism. An examination of the data given by the Floreys for their patients[1] reveals a relation between dosage of penicillin and the development of elevated blood-urea. Of five adults who received daily an average of 120,000 units or more, four showed a rise in blood-urea, whereas of four who received an average of 100,000 units or less, three maintained a normal level. The suggestion is made that this might be attributable in part to *in vivo* inhibition of urease.

JOSEPH C. TURNER.
FREDERICK K. HEATH.
BORIS MAGASANIK.

2nd General Hospital,
A.P.O. 647,
U.S. Army.

* Kindly supplied by Dr. E. Chain, of the Sir William Dunn School of Pathology, Oxford.

[1] Florey, M. E., and Florey, H. W., *Lancet*, **1**, 387 (1943).

Iron Excretion and Metabolism in Man

UNTIL 1937 it was generally considered that iron was absorbed with some measure of freedom in the duodenum and upper parts of the small intestine, and that any taken up in excess of the immediate requirements of the body was excreted into the large intestine. In that year we pointed out that if one neglected the traces of iron always present in the urine and in abraded cells there was no convincing evidence that iron was ever excreted by any of the organs of the body, and that most of the work which had been done tended to show that iron once absorbed remained inside the body[1]. In the years which followed we brought forward experimental evidence to support this theory[2,3,4] which must now be considered also to be well supported by other people's data[5,6,7]. Within the last six months, however, we have had the opportunity of putting the theory to a searching

test, and the results have been so convincing that we feel justified in placing them on record.

Mrs. H., aged sixty-six, fit, active and well until September 1942, was admitted to Addenbrooke's Hospital under the care of Dr. Leslie Cole in January 1943. She was found to be suffering from a very severe hæmolytic anæmia, and was specially investigated by Dr. Jacobson. She was kept alive only by frequent transfusions, and between February 11 and May 24 she was given twenty-eight pints of blood, all of which she hæmolysed. This blood must have contained about 8 gm. of iron, and its administration and hæmolysis in just over a hundred days means that about 80 mgm. of the metal were being set free inside the patient every day. If one considers that in the previous September, Mrs. H., as a normal woman, probably contained no more than 4 gm. of iron, it will be appreciated that she was being given more iron than she could possibly require, and that then, if ever, she should have been excreting it.

Between April 16 and May 18 we measured Mrs. H.'s intake and output of iron by the natural channels[6]. Over a period of seventeen days the iron in her food averaged 5·6 mgm. per day. Her urine contained 0·3 mgm. a day and her fæces 4·9 mgm., making a total excretion of 5·2 mgm. She was therefore in the slight positive balance of 0·4 mgm. a day, and there was no suggestion that Mrs. H. was excreting any of her superfluous iron. One can only suppose that she was unable to do so.

Much of the retained iron was undoubtedly stored in the liver, but all the organs probably participated to some extent. We have only had the opportunity of analysing her spleen, for Mrs. H. was cured by its removal on May 25. The organ was enlarged and weighed 350 gm. It contained 0·32 gm. of iron, only a fraction of the amount which had been given.

If the body never excretes iron, it follows naturally[1] that the amount absorbed must fluctuate in accordance with the requirements of the body. Using radioactive iron, Hahn *et al.*[6] showed that this was true for normal and anæmic dogs, but there is still a great deal to be found out about the absorption of iron, and about the ways in which this absorption is adjusted and controlled.

R. A. McCance.
E. M. Widdowson.

Department of Medicine,
Cambridge.
Aug. 20.

[1] McCance, R. A., and Widdowson, E. M., *Lancet*, **2**, 680 (1937).
[2] McCance, R. A., and Widdowson, E. M., *Quart. J. Med.*, **6** (N.S.), 277 (1937).
[3] Widdowson, E. M., and McCance, R. A., *Biochem. J.*, **31**, 2029 (1937).
[4] McCance, R. A., and Widdowson, E. M., *J. Physiol.*, **94**, 148 (1938).
[5] Fowler, W. M., and Barer, A. P., *Arch. Int. Med.*, **60**, 967 (1937).
[6] Maddock, S., and Heath, C. W., *Arch. Int. Med.*, **63**, 584 (1939).
[7] Greenberg, D. M., Copp, D. H., and Cuthbertson, E. M., *J. Biol. Chem.*, **147**, 749 (1943).
[8] McCance, R. A., and Widdowson, E. M., *J. Physiol.*, **101**, 44 (1942).
[9] Hahn, P. F., Bale, W. F., Hettig, R. A., Kamen, M. D., and Whipple, G. H., *J. Exp. Med.*, **70**, 443 (1939).

l-Lysine Decarboxylase: Preparation of Specific Enzyme and Coenzyme

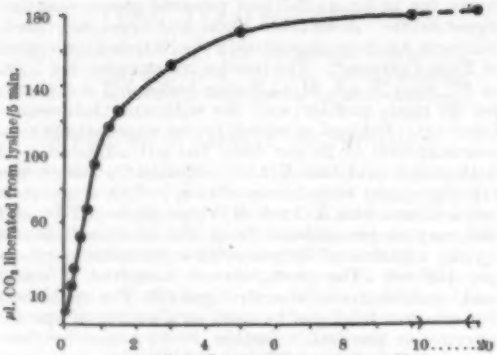
Strains of certain bacteria produce specific amino-acid decarboxylases when grown under acid conditions[1]. A cell-free preparation of *l*(+)-lysine decarboxylase has been made from acetone-dried powders of selected strains of coliform organisms grown for 24 hr. at 25° in 2 per cent glucose casein-digest-broth. A suitable paracolon organism, *Bact. cadaveris*, has been deposited in the National Collection of Type Cultures*. The powder is extracted for 2 hr. at 37° with *X* ml. *M*/45 borate buffer *p*H 8·5 (1 ml. per 20 mgm. powder) and the sediment then centrifuged off. Ethanol is added to the supernatant to a concentration of 20 per cent, the *p*H adjusted to 5 with acetic acid and *X*/2 ml. alumina Cγ suspension (16 mgm./ml.) added immediately. The alumina is twice eluted with *X*/2 ml. *M*/5 phosphate *p*H 7·0 and the enzyme precipitated from the combined eluates by the addition of 50 gm. solid ammonium sulphate per 100 ml. The precipitate is dissolved in water and insoluble material centrifuged off. The opalescent supernatant fluid can be used as a source of specific enzyme or purified a further 10–12 times by fractional ammonium sulphate precipitation as shown in the accompanying table.

Steps in the purification of *l*-lysine decarboxylase from a strain of *E. coli*.

Stage	Preparation	Ml.	Mgm. C/ml.	Total units	$Q^0_{CO_2}$
1	Intact organism				508
2	Acetone powder suspension	230	2·6	1610	860
3	Extract from acetone powder	225	2·95	1022	1,850
4	Eluate from alumina Cγ	204	1·02	710	4,100
5	Precipitated with $(NH_4)_2SO_4$ 50 gm. per 100 ml.	100	1·63	571	4,260
6	First $(NH_4)_2SO_4$ fractionation—				
	(a) 0–40% sat. $(NH_4)_2SO_4$	25	1·50	42	1,360
	(b) 40–55% " "	25	0·97	420	21,100
	(c) 55–65% " "	25	1·15	23	1,160
7	Second fractionation (of 6b)				
	(a) 0–41% " "	15	0·869	132	12,200
	(b) 41–47% " "	15	0·448	232	41,300
	(c) 47–52% " "	15	0·353	17	3,780
8	Third fractionation (of 7b)				
	(a) 0–42% " "	10	negligible		
	(b) 42–47% " "	10	0·209	80	46,000
	(c) 47–52% " "	10	0·49	131	32,000

The enzyme is tested manometrically at 30° in the presence of 2 ml. *M*/5 phosphate buffer *p*H 6·0 and 0·5 ml. *M*/15 *l*(+)-lysine, the carbon dioxide evolution followed over the first 10 min. after mixing and activities expressed as $Q^0_{CO_2}$ = μl. carbon dioxide liberated/hr./mgm. carbon of enzyme preparation. Carbon contents are estimated by the method of van Slyke and Folch[2]. One unit of enzyme is defined as that amount liberating 100 μl. carbon dioxide from lysine in 5 min. Under these conditions, the preparation at stage 5 can be used for the rapid estimation of *l*(+)-lysine; using 0·5 ml. of such a preparation in each manometer for the estimation of 0·5 ml. *M*/30 lysine (theory = 373 μl. carbon dioxide) a series of nineteen tests gave mean gas output of 344 μl.; stan. dev. 4·7; range 337–354. This output represents 92 per cent theory, but if carbon dioxide retention is estimated by the 'acid-tip' method[3], then the output represents 98 per cent theory.

The enzyme is optically specific and has been used for the resolution of *dl*-lysine and the preparation of *d*-lysine. Of the sixteen amino-acids previously listed[1], *l*-lysine is the only one attacked. The molecule is not attacked if it is acetylated in the α or ε position. Samples of hydroxylysine kindly given by Dr. D. D. van Slyke were slowly, but incompletely, attacked. The enzyme is optimally active at *p*H 6·0 and has a Michaelis constant of 0·0028 *M*. The preparations are rapidly and irreversibly inactivated by dialysis against water.



EFFECT OF COENZYME CONCENTRATION ON RATE OF DECARBOXYLATION OF *l*-LYSINE BY SPECIFIC PROTEIN

Manometer cups contain: 0·25 ml. specific protein solution; 0·5 ml. *M*/15 *l*-lysine; 2·0 ml. *M*/5 phosphate buffer *p*H 6·0; 0·25 ml. coenzyme solution containing amounts above.

Two or three successive precipitations of the protein (stage 5) with 60 per cent saturated ammonium sulphate containing 10 per cent ammonia result in the preparation of an inactive protein reactivated by the presence of boiled enzyme, boiled yeast or bacteria, etc. The specific protein cannot be reactivated by coenzymes I or II, flavineadeninedinucleotide, flavinephosphate, thiamin, thiamindiphosphate, etc., alone or in combination. Spectroscopic examination of ashed enzyme does not reveal the presence of any metals. The addition of extracts of boiled tissues to the specific protein shows that the coenzyme has a wide distribution, being present in rat liver, skeletal muscle, heart, kidney, brain and gut; brewer's and baker's yeast; all bacteria tested, and in cabbage leaves and the garden pea. It is not feasible at present to work up bacteria, so brewer's yeast has been chosen as the richest convenient bulk source for the isolation of the coenzyme.

The coenzyme can be extracted from air-dried brewer's yeast by weak alkali but not by water or acid. Since the barium salt is soluble in water, the yeast is first extracted with ten times its weight of 0·75 per cent baryta solution in the cold. Barium is removed from the extract with sulphuric acid and the neutralized centrifugate poured into 5 vol. alcohol. After removal of the precipitate, barium acetate is added to the filtrate and the precipitate collected. The coenzyme is apparently adsorbed on the barium sulphate under these conditions and can be purified some thirty times by exhaustive washing of the precipitate with hot water, followed by decomposition in sulphuric acid. The acid centrifugate is extracted with phenol to remove flavine-like substances, saturated with ammonium sulphate and re-extracted with phenol. The coenzyme is removed from the second phenol extract by shaking with water in the presence of ether. The water solution is acidified with nitric acid, extracted with *iso*-butyl alcohol, the coenzyme extracted from the alcohol with *N*/10 sodium hydroxide and precipitated as the lead salt. The final stage consists of alcohol fractionation of the barium salt. The purest fraction so far obtained is precipitated by 30 per cent ethanol, but a further, slightly less pure, fraction can be obtained by increasing the ethanol concentration to 50 per cent, dissolving the resulting precipitate in water and refractionating with 30 per cent ethanol. The coenzyme can be dried and kept indefinitely as the lead salt. From 1 kilo. dried yeast a yield of 15–20 mgm. lead salt (0–30 per cent ethanol fraction) can be prepared.

This preparation, after removal of the lead as lead sulphate, will activate the specific protein as shown in the accompanying figure, the half-saturation value corresponding to a concentration of 0·27 μgm. C of coenzyme preparation per ml. Over the range where the carbon dioxide liberation is proportional to the amount of coenzyme added, the activity, μl. carbon dioxide liberated/hr./mgm. carbon of coenzyme preparation, is 1,800,000. The coenzyme solution is deep yellow in colour, shows no flavine-like fluorescence, gives a positive Bial's reaction, and gives on analysis of the lead salt (Weiler): C, 22·18 per cent; H, 3·32 per cent; N, 5·07 per cent; P, 3·02 per cent; Pb, 41·2 per cent.

Tested enzymatically, the coenzyme is unaffected by boiling for 4 hr. in *N*/10 sodium hydroxide, but is destroyed in 60–90 min. by *N*/10 sulphuric acid at 100°. These hydrolyses are unaffected by reduction with cysteine or hydrosulphite. Work is proceeding on the nature of the groups in the coenzyme molecule, and it is hoped to publish full details in due course.

We are indebted to the Medical Research Council for a full-time grant to one of us (H.M.R.E.) and for a part-time grant for technical assistance.

ERNEST F. GALE.
(Beit Memorial Research Fellow.)
HELEN M. R. EPPS.

Biochemical Laboratory,
Cambridge. Aug. 21.

* N.C.T.C. No. 6578.
[1] Gale, E. F., *Biochem. J.*, **34**, 392, 846 (1940); **35**, 66 (1941).
[2] van Slyke, D. D., and Folch, J., *J. Biol. Chem.*, **136**, 509 (1940).
[3] Woods, D. D., and Clifton, C. E., *Biochem. J.*, **31**, 1774 (1937)

Ultra-Violet Light and Apparent Vitamin C

I AM indebted to Dr. Griffiths[1] for pointing out the incorrect reference to the method of preparing reductone which inadvertently was included in our note published in NATURE of July 3. His suggestion that reductones might be produced by the action of the ultra-violet light in sunlight is of some interest.

We have carried out experiments on the irradiation of different dehydrated foods in air, using a mercury vapour lamp with filters to cut out rays below about 280 mμ which would not occur normally in sunlight, and have not obtained any evidence of formation of reductone. Our experiments were carried out on foodstuffs irradiated for different periods up to six hours in aqueous solution at 12 in. from the lamp, using air-filled glass containers (covered Petri dishes). The *p*H of the solutions was between 4 and 6.

Dye titrations on samples taken at intervals showed no increase in the content of reductones or other constituents of apparent vitamin C in foodstuffs in which considerable amounts of this could be produced by prolonged storage in the dark under normal conditions. When foodstuffs were used in which the apparent vitamin C had developed during storage in the dark, this apparent vitamin C was almost entirely destroyed by a few hours irradiation. This is in keeping with the finding of Euler and Martius[2] that reductone has an absorption maximum at 287 mμ at *p*H 5·7 or higher, shifting to 268 mμ at *p*H 4·0 or lower. It would therefore seem desirable in storage experiments on vitamin C to use con-

tainers of amber glass which does not transmit any radiation below 370 or 380 mμ. This should avoid photochemical destruction of apparent vitamin C in the form of reductone, reductic acid or dihydroxymaleic acid, also of true vitamin C, which Mohler and Lohr[3] found to have a subsidiary maximum at about 350 mμ in potassium cyanide solution, equivalent to about 340 mμ in water. There is evidence that the vitamin C in fruit syrup stored in white glass bottles under normal conditions may be destroyed by sunlight.

While our results have not provided any evidence for the production of apparent vitamin C by the action of sunlight on processed foods, the position may be different in regard to natural foods such as fruits which are subjected to prolonged solar radiation during ripening and contain enzymes and pigments which may modify the conditions.

FRANK WOKES.

Ovaltine Research Laboratories,
King's Langley, Herts.
July 28.

[1] Griffiths, J. G. A., NATURE, 152, 163 (1943).
[2] Euler, H. v., and Martius, C., *Annalen*, 505, 73 (1933).
[3] Mohler, H., and Lohr, H., *Helv. Chim. Acta*, 21, 485 (1938).

Vitamin C and Carbohydrate Metabolism

IT has been shown previously[1,2] that deficiency of vitamin C in guinea pigs leads to a change in the carbohydrate metabolism as judged by (1) the glycosuria, (2) the diabetic type of the glucose tolerance curve, and (3) the depletion of the glycogen content of the liver. It has also been shown that the normal metabolism of carbohydrate is restored after the administration of vitamin C. From the above evidence, it has been suggested that the action of vitamin C is similar to that of insulin.

In the present investigation the insulin content of the pancreas of normal and scorbutic guinea pigs has been studied. Normal healthy male guinea pigs (200–300 gm. wt.) were selected. Some of the animals were fed on a scorbutic diet consisting of crushed barley, 64 parts; crushed gram, 20 parts; casein, 12 parts; common salt, 1 part; calcium carbonate 3 parts; cod liver oil, 2 c.c.; for a period of 24–28 days, until the animals developed scurvy. Other animals were fed on an ordinary diet consisting of green grass, germinated gram, outer green leaves of cabbage, etc., for two weeks.

Prior to the removal of the pancreas the animals were fasted overnight. The pancreases of 5–7 animals were pooled and extracted for insulin according to the method of Best *et al.*[3]. The crude insulin precipitate obtained was dissolved in normal saline of *p*H 2·5 so that 0·5 c.c. of the solution represented 1 gm. of pancreas. The potency of the solution was tested by studying the hypoglycæmic reaction in rabbits as described by Marks[4]. The results are shown in Tables 1 and 2. They definitely indicate that the insulin content of the pancreas is markedly diminished in scurvy.

TABLE 1. NORMAL GUINEA PIGS.

Aliquot No.	Number of guinea pigs	Weight of pancreatic tissue	Percentage blood-sugar reduction by the extract from 1 gm. of pancreas	Insulin content per gm. of pancreas
1	6	6·0 gm.	16·0	>1 unit
2	7	7·0	30·5	1·2 "
3	6	6·0	15·6	>1 "
4	7	5·6	13·0	>1 "

TABLE 2. SCORBUTIC GUINEA PIGS.

Aliquot No.	Number of guinea pigs	Days on scorbutic diet	Weight of pancreatic tissue	Percentage blood-sugar reduction with extract from 1 gm. of pancreas
1	5	26	5·5 gm.	0
2	6	24	6·0	0
3	5	24	5·0	0
4	6	28	6·0	0

International standard insulin was obtained through the courtesy of Dr. B. Mukerji, director of the Standardization Laboratory, Government of India. Thanks are due to Dr. B. M. Das Gupta, director of the School of Tropical Medicine, for his interest in the present investigation. SACHCHIDANANDA BANERJEE.

School of Tropical Medicine,
Chittaranjan Avenue,
Calcutta. June 14.

[1] Banerjee, S., *Indian J. Med. Res.*, in the press.
[2] Banerjee, S., *Indian Med. Gaz.*, in the press.
[3] Best, C. H., Haist, R. E., and Ridout, J. H., *J. Physiol.*, 97, 137 (1939).
[4] Marks, C. H., Quarterly Bulletin of the Health Organization, League of Nations, Geneva, Special Number, November 1936.

Short Wave-length Limit of the Continuous X-Ray Spectrum and Determinations of *h/e*

As is known, there exists a discrepancy between earlier determinations of *h/e* obtained from the short wave-length limit of the continuous X-ray spectrum and the value of *h/e* calculated from Bohr's formula for the Rydberg constant. Thus most of the determinations of *h/e* by the X-ray method have given values that are 0·3–0·4 per cent lower than the value calculated. This difference is several times greater than the stated limits of error, indicating the presence of systematic errors in the measurements. An error of this nature, due to too high a pressure in the X-ray tube, has previously been pointed out by me[1]. This error can amount to 0·1–0·15 per cent and is therefore too small to account for the whole of the discrepancy. Further, a number of determinations of *h/e* have been carried out by means of technical X-ray tubes in which the pressure was sufficiently low.

In the determinations of *h/e* carried out by me[2], with the aid of a bent crystal and Geiger counter, a very narrow spectral band could be used on account of the greater intensity of the method, and the voltage was varied by very small steps (about 2 volts). Only the very lowest part of the isochromats, up to about 10 volts from the threshold voltage, was investigated. This part of the curves proved to be linear and gave a sharply defined determination of the threshold voltage. The value obtained, $h/e = (1{\cdot}3787 \pm 0{\cdot}0008) \times 10^{17}$ erg. sec./E.S.U. agrees within the limits of error with the calculated value. In a later paper[3] I have described how I investigated the isochromats by the same method, up to 40 volts from the threshold voltage. The curves proved to be linear up to 10 volts from the threshold, where a maximum was obtained. From 10 volts upwards the intensity sank, reaching a minimum at 20 volts and rising again thereafter, though less steeply than before. This indicates the occurrence of a systematic error, by extrapolating from the upper part of the curve.

I have now adopted a series of isochromats of the wave-lengths 2498·42 X.U. (vanadium $K\alpha_1$) and

2285·03 X.U. (chromium $K\alpha_1$) to investigate the size of this error of extrapolation. The illustration shows a curve taken at $\lambda = 2285{\cdot}03$ X.U. Up to 20 volts from the threshold the voltage was varied in 2-volt steps and then in greater steps. The lowest straight part of the curve gives a value of the threshold voltage which agrees with the results of my previous investigations. On the other hand, an extrapolation from the upper part gives a value which is about 0·4 per cent lower.

In previous determinations of h/e broader spectral bands were used. The voltage was varied by steps that were too great to permit observation of the structure at the lowest part of the curves. The extrapolation therefore caused a systematic error and the values obtained were thus too low.

A precise determination of h/e by the isochromatic method is only possible, therefore, if a sufficiently narrow and well-defined spectral band is used, and the voltage varied by such small steps that the structure mentioned above appears.

A more detailed discussion of these problems will shortly be published in *Arkiv f. Matematik, Astronomi o. Fysik*.

PER OHLIN.

Physical Institute,
University, Uppsala. July 20.

[1] Ohlin, P., NATURE, **145**, 223 (1940).
[2] Ohlin, P., Diss. Uppsala (1941).
[3] Ohlin, P., *Arkiv f. Mat., Astr. o. Fys.*, **29**, A, No. 3 (1942).

Variations of Ultra-Violet and Daylight Rays

A DAILY record of daylight and near ultra-violet rays has been kept for the last eleven years, covering a sunspot cycle, at a site on the slopes of the Pennine hills about ten miles north-east of Manchester. The results of daily and seasonal observations are of considerable interest, but passing over these, attention may be given to what has taken place in the current solar cycle. At the time of sunspot minimum the daylight and ultra-violet rays had a maximum intensity; and as the number of sunspots increased, the light rays of both classes gradually diminished, and at the sunspot maximum, which occurred in 1937, they came sharply to a minimum intensity. Since then, as the sunspots have grown fewer in number, the rays have again risen to greater intensity and are increasing in intensity as the period of sunspot minimum approaches.

The two classes of rays do not rise and fall at the same proportionate rate, the ultra-violet moving to the highest and falling to the lowest point more slowly than the daylight rays. A graph of the ratio of the ultra-violet to the daylight intensities brings this out clearly, and the graph, so far from being a straight line, shows that the ratio has a variation which agrees remarkably well with the variation of sunspots in the solar cycle.

Sir Edward Appleton[1] has shown that the ionization of the upper air changes in sympathy with the number of sunspots, and consequently the curve of ionization and the curve of the ratio of ultra-violet to daylight rays are closely alike. A consideration of these observations and relationships leads to a tentative view consonant with the facts.

Since ultra-violet and daylight rays are diminished and become least as the sunspot maximum is reached, when the sun is reputed to be most active, it would appear that the rays at that time must be impeded or absorbed. It is at that time that the ionization of the upper air is greatest, and if ionization is indicative of some condition which has the property, or is itself capable, of interfering with the passage of light from the sun to the earth, then the reduction of light intensity at this maximum period would be accounted for. When the impediment to the passage of light is lessened or removed, at the time of fewest spots and least ionization, increase of light intensity would be explained.

It might be expected that the increased activity of the sun at sunspot maximum would give rise to increased ultra-violet radiation, but according to Dr. Pettit of Mount Wilson Observatory[2], radiation of light from the sun could not vary, as it does, by 160–180 per cent in the solar cycle without a simultaneous large variation of the temperature of the sun, of the order of 1,000° C., and evidence for this is wanting.

It would seem that the large range of variation of ionization, and properties accompanying it, is set up by the emanation from the sun which is responsible for auroras and geomagnetic phenomena, and the large changes of ultra-violet and daylight rays are due to effects which accompany ionization and which behave as a partial shield to the rays.

The course of the *daily* and *yearly* variation of both classes of rays, which, however, are due to the changing altitude of the sun, also suggests that they suffer a partial shielding in a similar way.

It is probable that light radiation as it leaves the sun does not vary more than the variation of the 'solar constant', and the inequality of light received on the earth in the solar cycle is the result of an inequality of shielding.

It is interesting to watch at the present time, as the minimum of sunspots is approaching, the remarkable growth of light intensity. In 1937 at the maximum of sunspots, ultra-violet and daylight intensities were, in arbitrary units, 422 and 764 respectively, while last year they rose to 720 and 1,817 and are still rising.

J. R. ASHWORTH.

55 King Street South,
Rochdale. Aug. 12.

[1] Appleton, *Phil. Mag.*, Ser. 6, **27**, 144 (1939).
[2] Pettit, *Astrophys. J.*, **75**, 185 (1932).

Spore-forming Bacteria in Potatoes

IT is generally accepted by plant pathologists that no spore-forming bacterium (Bacillus) is directly responsible for disease in plants and that such as are associated with lesions are saprophytes or secondary invaders. Accounts and even detailed experiments[1] have appeared from time to time attributing pathogenic powers to certain species of the *subtilis* group, notably *Bs. mesentericus*, but these have not been confirmed.

In the spring of this year several lots of stored potato tubers affected by bacterial rot were submitted by the Ministry of Agriculture and Fisheries to me for investigation, and from one of these in which the interior had been converted into a gummy transparent mass a spore-forming bacterium was isolated. Provisionally identified as *Bs. polymyxa* (Prazmowski) Migula by Dr. T. Gibson of Edinburgh, this organism produces a complete rot with evolution of much gas when inoculated on to slices of fresh potato, carrots, onions, cucumber and iris stems. *Bs. polymyxa* was re-isolated from some of these slices and re-inoculated into a further series of slices with similar results. This has been repeated several times at temperatures varying from room temperature to 37° C., and there can be no doubt that the spore-former *Bs. polymyxa*, a normal inhabitant of soil, is pathogenic to plants under certain conditions.

Up to the present most bacterial potato rots have been ascribed to the well-known non-spore-formers, *Bact. carotovorum*, *Bact. aroideæ* and *Corynebacterium sepedonicum*, but from the present investigation it seems evident that under certain conditions of storage potato tubers can be rotted by some species of spore-forming bacteria. The conditions under which these bacteria are able to invade tubers are only partially known and merit more extensive investigation than has hitherto been accorded them in view of the serious losses caused. Further work is proceeding.

W. J. DOWSON.

Botany School,
Cambridge.
Aug. 22.

[1] Brierley, P., *Phytopathology*, **18**, 819 (1937).

Colour of Red Blood Corpuscles

A SINGLE red blood corpuscle, illuminated by white light, appears yellow under the microscope. Why does it not appear pink? I have asked distinguished zoologists, physiologists, histologists and authorities on colour-vision, but only one has given even a tentative answer, though all have agreed to the fact. The yellow appearance is mentioned by the authors of a few histological text-books, but they either make no comment or else suggest that one would expect yellowness on account of the thinness of the coloured layer. The change of colour of certain dyes on dilution is sometimes attributed to different degrees of dissociation of the dye molecule, but the yellow appearance of a single red blood corpuscle must clearly be attributed to some special phenomenon of colour-vision that is not a matter of general knowledge among biologists.

The subject is important apart from its intrinsic interest, especially in connexion with the application of chemical colour-tests to microscopical objects. It frequently happens that when a red or purple reaction is expected, a yellow appearance is given. This happens particularly with the various aldehyde reactions for tryptophane. Test-tube experiments show a purple or purplish-red reaction, and massive protein-bodies in cells show a similar colour. The cytoplasm itself, however, generally appears yellow in thin sections, and the interpretation is difficult. An understanding of the tendency of pale red objects to appear yellow would help in the interpretation of histochemical colour-tests applied to very minute objects, such as mitochondria and the dictyosomes of the Golgi element.

JOHN R. BAKER.

Department of Zoology and
Comparative Anatomy,
University Museum,
Oxford. Aug. 14.

Length of Life of Sperms in the Woodlouse *Armadillidium vulgare* Latr.

RESULTS which could only be explained by the suggestion that sperms can be stored in females of *A. vulgare* for at least a year and that sperms are still viable after this storage have already been published[1,2]. Further evidence for this suggestion has now been obtained. In 1941 the two black females, *EC* and *EK*, were mated with the red males, *JDA* and *JDB*, respectively. Both females produced a brood in the summer of 1941 and they were both kept separate from males in the winter of 1941–42. Nevertheless both females again produced broods in the summer of 1942, and the composition of these broods (brood 176 from female *EC*, 20 red : 17 black; and brood 175 from female *EK*, 8 red : 4 black) shows that they were not produced by parthenogenesis since red colour is due to a single dominant gene.

H. W. HOWARD.

School of Agriculture,
Cambridge.
Aug. 27.

[1] Howard, *J. Genet.*, **40**, 83 (1940).
[2] Howard, *J. Genet.*, **44**, 143 (1942).

Ocular Muscles and Vision

THE double function of the ocular muscles, as described in my letter in NATURE of April 10, p. 422, explains many illusions, one of which has been freely discussed without any satisfactory explanation. This refers to the apparent appearance of a moving motor-car or carriage, as if it were standing still. The eye on moving takes a fresh photograph, which is seen for an appreciable time. The decomposed visual purple is swept out of the way by the back pressure. Note the difference in appearance of a tennis or cricket ball when the eyes are still and when they are moving following the ball. A very curious example may be seen at a cinema. If, when an orator is speaking, the eyes be directed to another part of the picture and then immediately be turned back again to the orator, he will be seen quite still, with his mouth open or closed, while his voice goes on.

F. W. EDRIDGE-GREEN.

45 Dollis Hill Avenue,
London, N.W.2. Aug. 3.

RESEARCH ITEMS

Blood Groups of the Tharus

THE Tharus are a primitive people living mainly in fen-land areas of the United Provinces, Bihar and Orissa. Their total population as recorded in the 1931 census is 77,021. Women play a dominant part in Tharu society and the menfolk have adapted themselves to a subservient position. The traditional explanation of this is that the Tharus are offsprings of mixed marriages between Rajput women and their servants. D. N. Majumdar has taken blood samples from 241 males and 82 females, and his results show a very high incidence of the *AB* group (18·4 per cent for males, and 18·3 per cent for females) ("The Tharus and their Blood Groups". By D. N. Majumdar. *J. Roy. Asiatic Soc., Bengal* (Science), **8**, No. 1; 1942). The Tharus, living as they do in a malarious and unhealthy country, have been popularly known as immune from malarial infection. While measuring his sample, the investigator found a number of them suffering from fever, and he noted that most of the latter belonged to group *A*, whereas 78 per cent of the (*B*+*AB*) group said on inquiry they were not habitual victims of malarial infection.

Peruvian Skeletal Remains

THE classification and racial relationships of much Peruvian cranial material are difficult to determine owing to artificial deformities. T. D. Stewart has studied metrically miscellaneous undated skulls from the Chicama-Moche-Virú region, and some smaller series from Cupisnique and Mochica graves ("Skeletal Remains from Cultural Associations from the Chicama, Moche, and Virú Valleys, Peru". By T. D. Stewart. *Proc. U.S. Nat. Mus.*, **93**, No. 3160). He comes to the conclusion that the undeformed Chicama series is about as homogeneous as the American undeformed crania available for comparison from one culture or site. He concludes, also, that there are certain significant differences between the deformed and undeformed series that are independent of deformity. There is a possibility that these differences likewise may distinguish the Cupisnique and Mochica remains, the only demonstrable morphological difference of which is based upon the presence of fronto-occipital deformity in the former case. His final suggestion, that the classification of Indian physical types should wait upon a better definition of skeletal material, will find support among other authorities.

Microbiological Degradation of Sterols

IN general, the sterol content of soils has received little attention although the wide distribution of free or esterified sterols in animal and vegetable tissues must result, during their decay, in the deposition in soils of an appreciable quantity of sterol substances. G. E. Turfitt (*Biochem. J.*, **37**, 115; 1943) has determined sterol contents of certain British soils and finds that there are definite relationships between sterol content and soil type. Deposition of sterols must depend primarily on the nature and number of the animal and plant inhabitants, so that deposition will be at a maximum in soils favourable to the maintenance of a flourishing population. Extreme acidity, lack of aeration and excessive water content are all factors which, either individually or collectively, inhibit the decomposition of humus and its constituent sterols and are thus responsible for the high sterol content of bog and fen peats. These adverse factors have been counteracted in arable soils, and the content of any soil shows a gradual decrease when replenished by organic manuring. The disappearance of sterols from soils cannot be due to the leaching action of rain-water, since sterols are so insoluble in water, but is probably the result of decomposition by certain acid-tolerant aerobic bacteria.

Salmon of the Irish Rivers

THE Fisheries Branch of the Department of Agriculture, Dublin, continues its series of researches on the Salmonidæ in Irish waters ("Salmon of the River Corrib, together with Notes on the Growth of the Brown Trout in the Corrib System", by Arthur E. J. Went. *Proc. Roy. Irish Acad.*, **48**, B, No. 12; 1943. "Salmon and Sea Trout of the Waterville (Currane) River", by Arthur E. J. Went and T. Sankey Barker. *Sci. Proc. Roy. Dublin Soc.*, **23** (N.S.), No. 9; 1943). A large amount of information has now been gathered together on this subject, not only on scales and other data but also on the nature of the waters and geological formations over which they flow. The tributaries of the River Corrib exhibit many diverse characters, ranging from quite acid to alkaline waters having *p*H values of 8·1. The Waterville (Currare) River contains little or no lime; the waters of this system being either neutral or acid. It has not yet been proved by actual examination of the migrating smolts whether those of the individual tributaries are distinctive, but it is suggested that the abnormally large smolts may have been derived from one special locality within the river system. The River Corrib with its varied conditions is ideal for carrying out such an investigation when post-war conditions will allow it, and it is suggested that it would be very interesting to ascertain whether the varied growth-rates of the brown trout in this system have a parallel in growth (and age at migration) of the young salmon from each of these localities.

Thrips Resistance in Cacao

THE cacao thrips (*Selenothrips rubrocinctus* Giard) is native to tropical America but is now widely distributed and occurs in most cacao-growing countries. It ranks as an important pest in the West Indies, Brazil, and West Africa. It spends its life on the leaves and pods of the cacao tree, and when attacks are severe defoliation results. The resistance of particular plants to thrips attack is a subject that has been investigated by the Entomology Department of the Imperial College of Tropical Agriculture in Trinidad. A preliminary account of this inquiry by Dr. E. McC. Callan is contained in *Tropical Agriculture*, **20**, 127 (1943). The studies were initiated in 1939 and were based on the fact that it had been observed on occasion that certain individual cacao trees supported very few thrips when the surrounding trees were heavily attacked. Some thirty apparently resistant trees were selected, and of these twenty-seven were found in Trinidad and three in Grenada. Among them *RT*18 is the outstanding selection made, being not only thrips-resistant but also a good commercial type of cacao. Statistical analysis of thrips-population counts on this tree and four surrounding trees shows that the differences between the counts are highly significant, suggesting that *RT*18 is thrips-resistant. Population counts over a period of two years showed that the standard type of tree supports a population more than 7·5 times

greater than that of *RT* 18. The resistance property of cacao to thrips appears to reside in the leaf, which is to a large extent resistant to puncturing by the mouth-parts of the insect. A method is given of expressing the thrips resistance of a cacao type as a coefficient of resistance. The mean coefficient of resistance of *RT* 18, namely, 0·87, is based on the assumption that the susceptible standard type of tree *ICS* has a coefficient 0 and an immune type a coefficient 1.

Cocksfoot Grass

Dactylis glomerata normally has $2n = 28$ chromosomes. *D. Aschersoniana* has $2n = 14$ chromosomes. A. Müntzing (*Hereditas*, 29, 134; 1943) has discovered two haploid plants $2n = 14$ among twin seedlings of *D. glomerata*. In regard to the morphology of the spikelets these haploids were similar to *D. Aschersoniana*, but differed in several other respects from this species. One plant was sterile and rather weak, whereas the other, although male sterile, set seed from pollination of *D. Aschersoniana*. In place of $2n = 14$, the ten seedlings obtained had $2n = 21$, $2n = 24$, and $2n = 28$. The relationship of *D. glomerata* and *D. Aschersoniana* is being studied by the author and it is significant that the haploids obtained from *D. glomerata* differ between themselves in several characters: probably as the result of differing genes on the four sets of chromosomes of the plant.

Oxidation of Nitric Oxide

INVESTIGATIONS of Bodenstein and co-workers showed that the reaction $2NO + O_2 = 2NO_2$ is termolecular and homogeneous; later workers claim to have obtained evidence that there are surface effects and that the reaction is not entirely homogeneous. Stoddart (*J. Chem. Soc.*, 5; 1939) reported curious results, which indicated that reaction did not occur when the oxygen was added to the nitric oxide, and drying was not necessary to inhibit the reaction. J. H. Smith (*J. Amer. Chem. Soc.*, 65, 74; 1943) has re-investigated the reaction, the concentration of nitrogen dioxide being determined by a colorimetric method. Data were obtained over a 100-fold variation of nitric oxide concentration, at pressures from 0·5 to 50 mm. and at the two temperatures 0° and 25°. At moderately high pressures, and at low pressures when adsorption effects are eliminated, satisfactory agreement with previous results was found. At very low pressures adsorption and surface effects became marked, indicating complications due to adsorbed nitric oxide, and oxygen to a less extent. The reaction may be regarded as essentially homogeneous, the irregularities being marked only at very low pressures. Stoddart's result was not confirmed and was perhaps due to the circumstance that only a slight amount of nitric oxide entered the oxygen bulb. The results of the effect of water vapour seem of little interest, since the apparatus was merely warmed in out-gassing, the nitrogen dioxide was in contact with tap grease, and it is not stated if purified phosphorus pentoxide was used.

The System Alumina-Water

Two forms of alumina Al_2O_3, namely, corundum and γ-alumina, two forms of aluminium oxyhydroxide AlO(OH), namely, diaspore and böhmite, and two forms of aluminium hydroxide $Al(OH)_3$, namely, gibbsite and bayerite, are well established. The so-called β-, δ-, ζ-, and trigonal aluminas are spurious. The transition points as found by dehydration methods vary as much as 200°. A. W. Laubengayer and R. S. Weisz (*J. Amer. Chem. Soc.*, 65, 247; 1943) have used the hydrothermal method, which consists in keeping the substance in contact with superheated steam in a bomb. The crystalline substances obtained were identified by chemical analysis and by X-ray and microscopical examination. The products formed at higher temperature (300°–500°) were well crystallized and could be identified by their optical properties. The main results are as follows. Corundum is the stable phase above 450° ± 5°; γ-alumina is metastable throughout the range investigated. Diaspore is stable below 450° ± 5° and its lower limit of stability seems to be about 280°; it was prepared artificially (probably for the first time, as previous claims are very questionable) by seeding γ-Al_2O_3, held at 430° (240 atm.) for 40 hours in water, with diaspore. Böhmite is apparently stable between 155° and 280°; gibbsite is unstable above 155°; bayerite is unstable above 155° and is probably less stable than gibbsite below this temperature. It is noteworthy that diaspore can be obtained only by seeding, and without seeding böhmite is formed in preference to diaspore, even though the latter should be stable in given conditions.

Theory of Cepheid Variables and Novæ

F. Hoyle and R. A. Lyttleton have developed a new theory of Cepheid variables and novæ which has many attractive features, though it must be admitted that it is highly speculative and presents certain complicated features (*Mon. Not. Roy. Astro. Soc.*, 103, 1; 1943). The authors postulate a binary system in which most of the mass of each component is confined to a relatively small volume, and a common atmosphere surrounds both components, but the material of the atmosphere does not take part in the orbital motion of the system. A periodic gravitational field is responsible for *forced* oscillations of the atmosphere—a condition of affairs very different from Sir Arthur Eddington's pulsation theory, which takes account of *free* oscillations in the atmosphere. The physical properties of such a system are dealt with and certain important effects are shown to correspond to observational data. Thus, since the amplitude of the oscillation is greatest at the equator and zero at the poles, it might be expected that the apparent velocity of the surface and the variation in luminosity would decrease with increasing latitude of the earth's direction—a correlation actually discovered in 1937 by Joy. Among the many explanations of the characteristics of the Cepheids may be mentioned that relating to the period-luminosity relation and the $P\sqrt{p}$ law. When accretion by the system has reduced the separation of the components to fusion into a single body, this body would be rotationally unstable if the mass ratio is less than 3 : 1, and stability could be restored only by the ejection of a portion of the main rotating mass. Regions of the star at very high temperatures would thus become exposed and a nova would occur. It is shown that under reasonable assumptions of surface temperature before and during the outburst, an increase in luminosity of 10–12 magnitudes would be expected. In addition, it is suggested that a large amount of atmospheric gases would stream out between the two main components at the time of fission, and this might finally be responsible for the shells of gaseous material which form the planetary nebulæ.

BULB FORMATION AND FLOWER PRODUCTION IN ONION PLANTS GROWN FROM SETS

By O. V. S. HEATH and M. HOLDSWORTH
Imperial College of Science and Technology, S.W.7

THE dependence of bulb formation in the onion on the stimulus of long days has been well established[1,2,3,4,5], and also the interaction of day-length with temperature[3,5]; a day-length just adequate at high temperature fails to induce bulb formation at low temperature, or leads to long delay. With regard to inflorescence emergence ('bolting') Thompson and Smith[3] recorded a large temperature effect but no effect of photoperiod, a lack of response attributed by Heath[5] to the limited range of day-length covered in their work. Heath concluded that conditions favourable to bulb formation (long days, high temperatures) are inimical to bolting and vice versa. In this communication an outline of the further analysis of this apparent antagonism is presented.

In a large factorial experiment we raised plants from sets (small bulbs) in which no inflorescence primordia were present at planting time (March 1942). Throughout the summer these plants were given 11½-hr. daily illumination at each of two temperature ranges (means 18° C. and 26° C. respectively). In early October half of each lot was transferred to 16½-hr. days (daylight supplemented with electric light). At the high temperature range (mean October–January 24° C.) in long days, bulbing began five weeks after transfer and then rapidly became general. No inflorescences appeared in this treatment. At the lower temperature (mean 14° C.) in long days, only 7 per cent of the plants had bulbed by ten weeks from transfer, and even at sixteen weeks when the experiment was ended only 40 per cent had produced bulbs. In this treatment, 7 per cent of the plants had produced inflorescences by ten weeks and 21 per cent by sixteen weeks. It is worthy of note that only one plant bolted *after* having been recorded as showing signs of bulb formation. Among all the plants remaining in short days (11½ hr.) only two, at the high temperature, formed bulbs and none showed inflorescences. The results are presented in Table 1. At the end of the experiment all the plants were pickled and were later dissected to ascertain the stage of development of the growing point. Data from the dissections are given in Table 2.

It is apparent that the plants grown at high temperature in either long or short days showed no signs of inflorescence development but were still in a vegetative condition; whereas at the low temperature in both day-lengths 65 per cent of the plants had initiated inflorescences. A difference, however, is seen, for whereas in the 11½-hr. days only $\frac{1}{17}$ of the inflorescences had scapes of more than 12·5 mm. in length, in the 16½-hr. days $\frac{7}{15}$ showed such scapes. The following conclusions are drawn from the data:

(1) At temperatures low enough to prevent or sufficiently delay bulbing, long days actually accelerate the emergence of inflorescences (Table 1 *B*, column 4).

(2) The action of long days in suppressing inflorescence emergence under conditions favourable to more rapid bulb formation[6] is therefore presumably an indirect effect connected with the bulb development that they promote.

TABLE 1. DEVELOPMENTAL DATA FROM TIME OF TRANSFER (OCTOBER 6, 1942) TO END OF EXPERIMENT (JANUARY 26, 1943).

	Weeks		11½ hr. day		16½ hr. day	
			High temp. (Mean 24° C.)	Low temp. (Mean 14° C.)	High temp. (Mean 24° C.)	Low temp. (Mean 14° C.)
			1	2	3	4
A.	6	% of plants bulbing. ( ) = % ripe bulbs.	—	—	64 (0)	—
	8		—	—	92 (1½)	—
	10		1½ (0)	—	100 (5)	7 (0)
	12		1½ (0)	—	100 (21)	18 (0)
	14		1½ (0)	—	100 (48)	30 (0)
	16		3 (0)	—	100 (67)	40 (2)
B.	10	% of plants bolting.	—	—	—	7
	12		—	—	—	12
	14		—	—	—	19
	16		—	—	—	21

TABLE 2. TERMINAL INFLORESCENCES (EMERGED AND INITIATED) BY JANUARY 26, 1943. (DATA FROM DISSECTIONS.)

	Scape length	1	2	3	4
% of plants with inflorescences	>20 cm.	—	—	—	21
	20 cm.—12·5 mm.	—	12	—	30
	12·5—0·78 mm.	—	38	—	14
	<0·78 mm.	—	15	—	—
	Total	—	65	—	65

(3) There is a direct effect of high temperature in suppressing inflorescence initiation quite apart from the accelerating effect on bulbing, for not a single primordium was found at the high temperature in either day-length, although bulbing in short days was almost negligible.

(4) The rate of initiation of inflorescences is apparently unaffected by length of day, since 65 per cent of the plants showed primordia in each day-length. (The alternative hypothesis, that initiation began sooner in the long-day plants but afterwards came to an end, is less acceptable. It seems unlikely that 35 per cent of the plants were inherently incapable of forming primordia; as for the possibility of initiation being prevented by bulb development in the long-day plants, the presence of unemerged inflorescence initials at the end of the experiment was quite unrelated to the presence or absence of bulbing.)

The acceleration of inflorescence emergence by long days (Table 1 *B*, column 4) is thought to be brought about, in part perhaps, by an observed increase in the rate of elongation of the surrounding foliage leaves, but mainly, by a great increase in the rate of scape elongation (Table 2). In this respect the effect of long days resembles that described for spring cereals[6]. All the evidence to date (including further work by Heath and Mathur) supports the hypothesis that bulbing prevents emergence of the inflorescence, and since foliage leaves are similarly affected[6] it appears that bulbing inhibits longitudinal expansion of all organs. (Sideris[7] records that the original root system begins to die at the time of bulb formation; new roots do not appear until about three weeks later in soil cultures.) It is remarkable that long days by promoting radial extension (bulbing) at moderate and high temperatures should suppress longitudinal extension, whereas at a somewhat lower temperature long days accelerate longitudinal extension. It appears that as the days lengthen in spring a race between the processes of scape elongation and bulb formation must often occur, the resultant incidence of bolting being determined by the diametrically

opposed effects of long days according to whether the temperature is or is not high enough for rapid bulbing. To this opposition may be attributed much of the apparently erratic bolting of onions grown from sets in various seasons and localities. The suppression of bolting by high temperatures in the absence of bulbing is unlikely to be of importance in Great Britain, as temperatures are seldom high enough except in the long summer days such as favour bulb formation.

It must be emphasized that the above experiments were performed with sets, and the plants had therefore been exposed to long days in the previous year during their production from seed. A further experiment starting with seeds may therefore be cited, in which the day-length was maintained throughout at less than twelve hours. These plants formed no bulbs, but produced inflorescences after some eighteen months. Clearly, therefore, at no stage during ontogeny are long days essential either for initiation or emergence of inflorescences, unless indeed the particular variety of onion used for this experiment was characterized by an exceedingly low photoperiodic requirement for flowering.

The experiments here discussed and further work now in progress will be published in full in due course.

[1] McClelland, T. B., *J. Agric. Res.*, **37**, 603 (1928).
[2] Magruder, R., and Allard, H. A., *J. Agric. Res.*, **54**, 719 (1937).
[3] Thompson, H. C., and Smith, O., Cornell Univ. Agric. Exp. Sta., *Bull.* 706 (1938).
[4] Heath, O. V. S., (Pt. 1), *Ann. Appl. Biol.* (In the press).
[5] Heath, O. V. S., (Pt. 2), *Ann. Appl. Biol.* (In the press).
[6] Purvis, O. N., *Ann. Bot.*, **48**, 919 (1934).
[7] Sideris, C. P., *Amer. J. Bot.*, **12**, 255 (1925).

RESEARCH ON EARLY MAN IN BURMA

OF recent years it has become increasingly evident that so early as lower palæolithic times human culture was not the same all over the world, and that the dissimilarities probably resulted from differences in race. Even in such a small area as the continent of Europe, it is clear from a study of distribution maps of stone age cultures that in Central and Eastern Europe the stone industries differ entirely from those found in the west, and furthermore the two groups undergo quite different developments. Whereas central and eastern Europe can obviously be linked with northern Asia, the stone industries of western Europe show close affinities with the lower palæolithic finds of the African continent. Although skeletal remains of this early date are extremely rare, the few sure indications that have turned up also seem to point to the same connexions. Now a third region has been entered and we find there a series of industries closely allied with others from south-east Asia, but dissimilar to their contemporaries in northern Asia or in Africa.

The *Transactions of the American Philosophical Society* (**32**) includes a scholarly account of the work undertaken, which was (1) to study the pleistocene period in Burma and to establish a chronological sequence for the alluvial formations of the Irrawaddy Valley, and (2) to investigate any stone age industries discovered in the course of the above researches. Heilmut de Terra, well known for his similar work in northern India, was responsible for (1), Hallam L. Movius, jun., for (2). Supplementary reports on the pleistocene vertebrates and molluscs of the region are given by Edwin H. Colbert and J. Bequaert respectively. There is also a note on an investigation undertaken by de Terra in Java. The geological chapters include studies of the Irrawaddy basin and in the northern Shan Highlands, as well as comparisons with neighbouring areas in India, China and Malaya. Movius describes a series of industries (Anyathian) which appear in early mid-pleistocene deposits. They resemble the Soan complex of northern India, as well as industries found at a number of sites in Java. The Soan always has been considered to have been intrusive in northern India; it would now appear to have been an outlier from Burma. Movius also notes the similarity between the Anyathian and certain heavy industries from Choukoutien, but the typical smaller industries from this area have not been found either in Burma or in Java. The later Anyathian (late pleistocene) though showing certain so-called upper palæolithic peculiarities, is essentially an evolution of the earlier Anyathian, and this is clearly shown from a study of the development of a series of specialized tools made from an unusual material, fossil wood. An interesting collection of neolithic implements and pottery was also made and studied. The first two appendixes are mainly catalogues of the pleistocene vertebrates and freshwater shells found. But de Terra's note on his visit to Java raises again the vexed question of the date of *Pithecanthropus erectus* and that of the newly discovered human remains at Modjokerto. The latter apparently must be considered to be earlier in age than Dubois' find.

In this short note it is impossible to give any detailed account of these investigations. The authors have opened up a new field of study, both in the realm of quaternary geology and of prehistory. Obviously, an enormous amount remains to be done, but the foundations are here for the first time well and truly laid. M. C. BURKITT.

A GIANT CAMERA

AN article by Richard Haard (*Bell Lab. Rec.*, **21**, No. 10; June 1943) describes the largest camera of its kind in the United States, this being installed in the Photocopy Department of the Bell Laboratories, making so many as eight hundred negatives a day. It was made by the Rutherford Camera Co. and has one of the largest lenses of its kind in the country—a Goertz apochromat with a 72-in. focal length. The camera also has three other smaller lenses, and all four are interchangeable. With this camera a negative $3\frac{1}{2}$ ft. $\times$ 6 ft. may be made as easily and quickly as one 8 in. $\times$ 10 in. The photographer works inside the camera, in complete darkness except for a dim red light.

The new camera consists of two rooms with the lenses mounted in a sliding panel in the separating wall. One is a dark room that has a giant "plate holder", called the "camera back", running on a track on the floor that extends through the wall carrying the lens, and into the "light" room. In this latter room, the easel that holds the tracing to be copied runs on a carriage on the same track. The easel is of the vacuum type. The flanged edges of the glass cover fit against rubber gaskets when the cover is lowered, and the vacuum which is then applied holds the drawing flat against the glass face of the easel so that all curves will be accurately reproduced. After this the easel, which is pivoted at the front edge of the carriage on which it rests, is tipped up

into a vertical position. It is equipped with piston devices that check its motion at the end of the swings so that tilting it up or turning it back is a simple and rapid procedure. Because of the height of the top of the easel carriage, which is half the length of the easel above the track, a bench 2 ft. high runs the entire length of the track to enable the operator to place the tracings on the easel. Two powerful arc lights on each side of the track near the lens provide illumination.

The "camera back" in the dark room is arranged for two widely different sizes of negatives. The vertical plate against which the paper is placed is perforated with fine holes, and a vacuum acting through them holds the paper flat. If the negative to be made is smaller than the perforated back, rubberized curtains are drawn from the top and bottom and from the two sides to block off all holes except those covered by the paper. Vertical bars control the two side curtains.

Four men form the normal operating crew of the camera. In the light room, a man at one of the work benches measures the drawing, and from the size of the print called for, calculates which of the four lenses should be used. Using a loud-speaking telephone system interconnecting the dark and light rooms, he tells the operator in the dark room the results of his calculation. Four horizontal scales run the length of the tracks in both rooms and are used in setting the positions of both easel and "camera back" in accordance with the size of the drawing and the amount of reduction required. One scale is marked for each lens. After the operator in the dark room has mounted the proper size paper on the "camera back" and selected the proper lens, he moves the "back" to the designated marking on the scale for that lens. In the meantime, another operator in the light room has placed the tracing in the easel, tilted the easel up, and moved the carriage to the scale mark given him by the operator who has sized the drawing.

After the dark-room operator has finished his operation, he looks through a small red glass window in the wall to the right of the lens, and as soon as he sees the easel is in place, he operates a switch that turns on the arc lights. He then rotates a filter into position in front of the lens to cut down all but a negligible amount of light, uncovers the lens, and looks at the faint image of the tracing on the sensitized paper. Using hand wheels at one side of the "camera back", he then shifts the vertical and horizontal position of the lens so as to centre the image on the paper. Following this, he removes the deep filter, or replaces it with one that will best bring out the lines on the drawings, and makes the exposure. He stops the exposure by turning off the arc lights, which also acts as a signal to the operator to place the next tracing in the easel.

The dark-room operator then removes his exposed paper and slides it through a chute to the adjacent developing room, where it is developed, washed, and fixed, and then placed on a glass-top under-lighted table for inspection. Any weak spots are brushed with ferricyanide so that they will print stronger. The negative is then passed through another chute to the washing tanks in the outer room. After the washing period, the prints are dried on the power-driven drier and then passed through the oiling machine. This spreads a thin film of oil on the back to make the paper more transparent, and thus to decrease the printing time. Any excess oil is then wiped off and the negative is ready for printing.

FORTHCOMING EVENTS

Saturday, September 18

BRITISH RHEOLOGISTS' CLUB (at Loughborough College, Loughborough), at 10 a.m.—Discussion on "Rheology in the Hosiery, Leather, Shoe and Allied Trades".

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at the Middlesex Hospital, London, W.1), at 2.30 p.m.—Discussion on "Clinical Photography".

Saturday, September 18–Sunday, September 19

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at the Royal Society, Burlington House, Piccadilly, London, W.1).—Eighteenth ASLIB Conference.

Saturday, September 18

10.30 a.m.—Annual General Meeting.
11.30 a.m.—Prof. J. D. Bernal, F.R.S.: "Positive Information Service".
2.0 p.m.—Symposium on "The International Rehabilitation of Special Library Services".

Sunday, September 19

10.30 a.m.—Mr. F. C. Francis: "The British Museum as a Special Library".
11.45 a.m.—Major Irving Newman: "The Organisation of American Photographic Information Services in Great Britain".
2.30 p.m.—Symposium on "The Co-ordination of Abstracting".
5.0 p.m.—"ASLIB: What it is Doing and What it Hopes to Do".

Wednesday, September 22

INSTITUTE OF METALS (at 4 Grosvenor Gardens, London, S.W.1), at 3 p.m.—Thirty-fifth Annual Autumn Meeting.

Friday, September 24

FARADAY SOCIETY (at the Hotel Rembrandt, South Kensington, London, S.W.7), at 10 a.m.—A General Discussion on "Modes of Drug Action".

Saturday, September 25

BRITISH PSYCHOLOGICAL SOCIETY (at Tavistock House, Tavistock Square, London, W.C.1), at 2.30 p.m.—"Education of the Adolescent".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SENIOR LECTURER IN ELECTRICAL ENGINEERING—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan (September 23).

PHYSICIST TO THE RADIOTHERAPY DEPARTMENT—The Secretary, University College Hospital, Gower Street, London, W.C.1 (September 27).

CITY ELECTRICAL ENGINEER AND CITY LIGHTING ENGINEER—The Town Clerk, Municipal Buildings, Liverpool 2 (endorsed 'City Electrical Engineer and City Lighting Engineer') (September 30).

ASSISTANT TO THE ADVISORY MYCOLOGIST for the Yorkshire Province—The Registrar, The University, Leeds (September 30).

CHAIR OF SOCIAL MEDICINE—The Secretary, The University, Edmund Street, Birmingham 3 (March 1).

UNIVERSITY LECTURER IN ANTHROPOLOGY—The Secretary of the Appointments Committee of the Faculty of Archæology and Anthropology, Museum of Archæology and of Ethnology, Cambridge (April 15).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Health. Third Report of the Central Advisory Water Committee: River Boards. (Cmd. 6465.) Pp. 73. (London: H.M. Stationery Office.) 1s. 3d. net. [196

Royal College of Physicians of Edinburgh. Annual Report by the Curator of the Laboratory for the Year 1942. Pp. 16. (Edinburgh: Royal College of Physicians of Edinburgh.) [248

Plan for Clean Air. Pp. 8. (Epsom: National Smoke Abatement Society.) 2d. [248

Freshwater Biological Association of the British Empire. Eleventh Annual Report for the Year ending 31st March 1943. Pp. 40. (Ambleside: Freshwater Biological Association of the British Empire.) 1s. 6d. [268

Other Countries

U.S. Office of Education: Federal Security Agency. Bulletin, 1941, No. 5: Bibliography of Research Studies in Education, 1939–1940. Prepared by Ruth A. Gray. Pp. xiv+404. (Washington, D.C.: Government Printing Office.) 50 cents. [128

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 92, 1940. Pp. iii+376. (Philadelphia: Academy of Natural Sciences.) 7.50 dollars. [178

Bulletin of the American Museum of Natural History. Vol. 81, Art. 3: Dentitional Phenomena in Cobras and other Elapids, with Notes on Adaptive Modifications of Fangs. By Charles Mitchill Bogert. Pp. 285–360+plates 48–51. (New York: American Museum of Natural History.) [178